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COXA VARA IN ADOLESCENCE*

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Reduction of the angle formed by the axis of the head and neck and that of the shaft of the femur may be brought about by numerous causes. Some of these are congenital deformity, with or without dislocation of the hip, fracture, rickets, osteomalacia, osteoporosis, osteomyelitis, and tuberculosis. Each of these produces a clinical picture which is easy to trace and understand. The name coxa vara was first given to the condition by Kocher and Hofmeister in 1894, although it had been described as early as 1857 by Richardson. Since then the various types have been much discussed in the literature, notably by Whitman, but interest has been largely centred in one single type, the so-called adolescent coxa vara. There is still doubt as to the etiology and mechanism of production of this type, and this paper will be limited to the consideration of these points. It is characterized by downward and forward displacement of the head on the neck.

The best recent discussion of coxa vara is that by René Bloch in the *Journal de Chirurgie*, Volume 18, 1921. He states that this type is always due to rickets of a delayed type occurring in individuals whose parents or older brothers and sisters usually show stigmata of rickets. He says the condition is not traumatic, as many other authors have held. Neither does he believe it is a purely static deformity. It seems to me that his evidence is insufficient to prove that rickets is the cause of the condition and that he has included other types than the one we are discussing here.

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The picture of the conditions is essentially as follows. At about the age of puberty, a healthy, but usually over-fat child, more often a girl, develops a limp. There may or may not be a history of a fall or strain, but it is rare that there is a history of severe injury. The limp is accompanied by some soreness in the hip or knee and by a disinclination toward the usual activities. "Leg-ache" after going to bed is frequently present. The symptoms rarely become sufficiently severe to incapacitate the child. If the parents are careful the child is usually taken to the family physician, who makes a diagnosis of a sprain or of rheumatism and prescribes simple remedies, thereby often lulling the family into a false sense of security, and they may do nothing more about it for a considerable period of weeks or months. Sooner or later the child is taken to some one who is sufficiently interested to make a complete and intelligent examination. It is then found that the child bears the earmarks of endocrine disturbance. There is abnormal fat, delayed genital development, mental heaviness, and general flabbiness of muscle tone. There is limitation of abduction and internal rotation in the affected hip and there is shortening of the leg of from one-half to one and one-half inches. There is no muscle spasm, pain, tenderness, or other sign of inflammatory disease or trauma.

Differential diagnosis must be made from tuberculosis, Perthes' disease, fracture of the neck, and traumatic separation of the epiphysis. This differentiation is easy if care in history taking, physical examination, and interpretation of roentgenograms is observed. Fracture and traumatic epiphyseal separation do occur in children, but their history is entirely different from that of coxa vara, and their physical examination is a picture of an acute injury.

The roentgenographic appearances in coxa vara are entirely dependent on the time elapsed since the onset of the trouble. They are

1st. Very early: A blurring of the epiphyseal line. A slight upward and backward displacement of the neck with regard to the head at the epiphyseal line. A sort of cupping of the head with rotation downward and backward of its articular surface. No change in the contour or structure of the neck.

2nd. Moderately advanced: Disappearance of the epiphyseal line. Further displacement upward and backward of the neck, which seems to be impacting itself in the further rotated head. No change in the shape of the neck. Slight absorption of lime salts in the head; less in the neck.

3rd. Late, after pain has disappeared: New deposit of lime in head and neck. Re-appearance of the epiphyseal line.

New bone formation like callus, which is bridging across from the capsized head to the neck all around its periphery.

4th. Stage of completed process: Full union of the head with the neck. A truss or arch of new bone continuous from the lower edge of the epiphysis along the lower surface of the neck for a greater or less distance. This distance depends on the amount of the original displacement.

A second truss or arch of new bone with convexity upward forms the upper union of the head and neck. This gives the appearance of an actual bend in the neck of the femur, and I believe accounts for the frequently advanced theory that bending of the neck of the femur is responsible for the coxa vara. It also accounts for the description of the various types of the deformity, the epiphyseal and cervical types of Whitman. The trochanteric type of Fröhlich is, I believe, an entirely different condition, due to rickets. The greater the original displacement the farther out on the neck the callus must extend and the shorter the arc of the arch found, but the greater the apparent involvement of the neck.

This explanation of the appearances found in a healed case of coxa vara adolescentium fits in perfectly with Wolff's law, in that new bone is deposited where it is needed. The short thick arch of bone on the under surface of the neck and head serves to take the increased load brought upon the neck and head through its loss of obliquity dependent on the downward displacement of the head in relation to the neck. It is hard to make it fit with Jansen's theories of bone absorption under stress and faulty mechanics as advanced by him in his work on Perthes' disease a coxa vara.

The foregoing represents, I believe, the development and mechanical explanation of the untreated case of coxa vara adolescentium.

Let us now see what happens when early treatment is instituted. There is no doubt in my mind what this treatment should be. It should be the forcible abduction and internal rotation of the femur, as advised by Whitman, in an effort to pull the lower edge of the neck out of the impaction into the head, which results from the forward and backward slip of the neck. When this impaction is overcome the normal relation between the two is automatically restored, and pressure is removed from the epiphyseal line. This abduction should be held completely until such time as the roentgenogram demonstrates bony union. This may be three, six, nine or more months. With this treatment, the obliquity and shape of the

upper end of the femur can be restored and maintained, and a hip with perfect function obtained.

In the foregoing description of the production of the deformity it will be noted that the mechanical changes originate at the epiphyseal line. It is there that the fundamental displacement occurs, and there that repair begins. The deformities are all sequelae of disturbances of the epiphyseal line. Successful treatment restores the relation of the head and neck and removes pressure from the epiphyseal line, and gives it time to resume its normal function. If these statements are correct, then it follows that the cause of the disease is a disturbance of function of the epiphyseal line. Just what this cause is I am not prepared to state, but I believe it lies in some change of function in the endocrine system. This change of function interferes with the normal activity and growth and bone formation at the epiphyseal line. The result is that the weakened epiphyseal line gives way under the weight of the unusually heavy child. Dr. Theodore A. McGraw of Detroit, who has done much valuable work on endocrine disturbances, has been kind enough to oversee several of my cases medically. We are both convinced that pituitary and thyroid medication has had a marked effect in hastening repair. The objection to this theory may be raised that a similar condition does not arise in other joints. This is easily answered by saying that the epiphyseal line of the upper end of the femur is the only one which has to undergo great and constant twisting strains in weight bearing. And if we care to wander still farther in the field of speculation, we may wonder if Köhler's disease of the tarsal scaphoid and metatarsals and Legg-Perthes' disease have not the same sort of explanation.

There is no doubt, of course, that rickets does produce a true bending of the neck of the femur, just as it produces bow legs, but such cases are easily differentiated from those under discussion by the fact that the head always holds its position on top of the neck. Legg-Perthes' disease may produce symptoms and signs very similar, but it never shows the downward displacement of the head.

The following cases are typical and are adduced in support of this paper.

Case 1. F. 1913. Patient is a very fat, flabby boy of thirteen. His father and older brother are very large and fat. Weight 160 pounds. Five months ago had a slight fall which bruised the hip somewhat. Hip was sore for a few days and uncomfortable. One month later he began to limp and has continued to do so. Has not been disabled.

Examination shows a very heavy boy who has not yet reached puberty. Right leg 29¼; left leg 29¼; right calf 13; left calf 13½; right side 21; left side 22. Right hip

FIG. 1

Boy, age 12. Slipping Epiphysis. Treated by manipulation and abduction. Full correction being obtained.

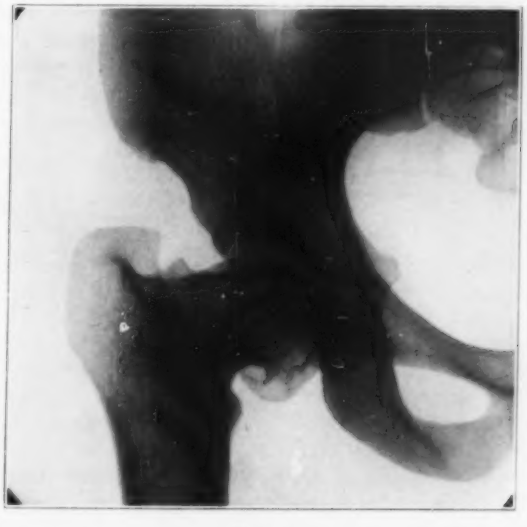

FIG. 2

Same boy seven years later. Excellent result functionally but imperfect anatomically because correction was not maintained sufficiently long.

allows only 10 degrees of flexion. Is held in 45 degrees of outward rotation and allows abduction of 5 degrees and adduction of 20 degrees. Obstruction is apparently bony and there is little or no pain on attempts at full motion. Roentgenogram shows typical downward displacement of epiphysis.

The boy was put up in full abduction under an anesthetic. The correction of the deformity required considerable force. All motions were obtained without any signs of fracture and the boy was kept in plaster for six weeks, and at the end of that time motions were practically normal. He was then allowed to get up on crutches and to take exercises. At the end of three months he was allowed to bear weight and walked without a limp. He then disappeared until 1923, when the roentgenogram (Fig. 2) showed the typical deformity. He was perfectly well, and a very powerful man, but abduction was still limited. All the signs of endocrine disturbance had disappeared. Evidently this patient was not held in a corrected position long enough.

Case 2. H. 1923. Large boy of twelve, heavier than usual for height. Somewhat dull and sullen. About three months ago family noticed that boy began to limp without apparent cause. Limp became slowly but steadily worse, and three weeks ago slight pain began. Family doctor made diagnosis of tuberculosis and put the boy in bed with an extension. Pain disappeared. Left leg is in full external rotation, 25 degrees internal rotation possible. Abduction impossible. More than 30 degrees of flexion causes pain. There is no spasm or fixed deformity, except external rotation and one inch shortening. Roentgenogram showed marked calcium absorption of proximal end of the neck and of the head. The neck was telescoped into the head, which was displaced downward and forward. This displacement was very marked.

Treatment consisted of full forcible abduction with internal rotation under an anesthetic, with fixation for three months in bed. Dr. T. A. McGraw gave a combination of pituitary and thyroid medication. Correction obtained was good and is maintained, but limitation of motion still persists. It is decreasing steadily as the calcium content of the bone returns. This limitation has occurred in one other severe case and is apparently due to thinning and atrophy of the joint cartilage dependent on interference with circulation.

This boy is now walking with a considerable limp, but there is no appreciable deformity, and the roentgenogram shows an excellent alignment of the neck.

Case 3. E. Z. 1923. This patient was a fat girl of eleven years. Always healthy. Appeared at the Children's Hospital in October, 1923, with a complaint of slight pain in the left hip when walking, and a limp. There was no history of rickets and all the family were perfectly healthy.

Examination showed that the left leg was one inch shorter than the right. There was little muscular spasm. There was fixed abduction and external rotation. The motions of the hip showed limitation of abduction, normal flexion, and limitation of rotation. No signs of inflammatory reaction in the joint.

This patient was put up in plaster in full abduction and internal rotation on November 23, 1923. She was kept in this position until March 1, 1924, and was treated with small doses of pituitary extract and thyroid extract. On March 10 the motions of her hip were normal. The roentgenogram showed excellent position without deformity, but the patient has not yet been allowed to walk.

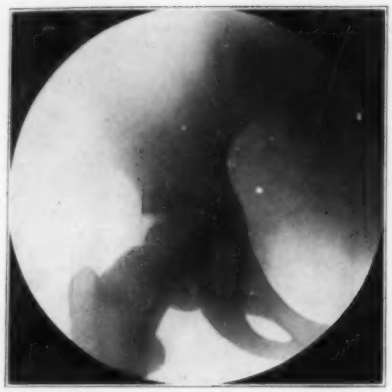

FIG. 3

Girl, age10. Slipping Epiphysis.

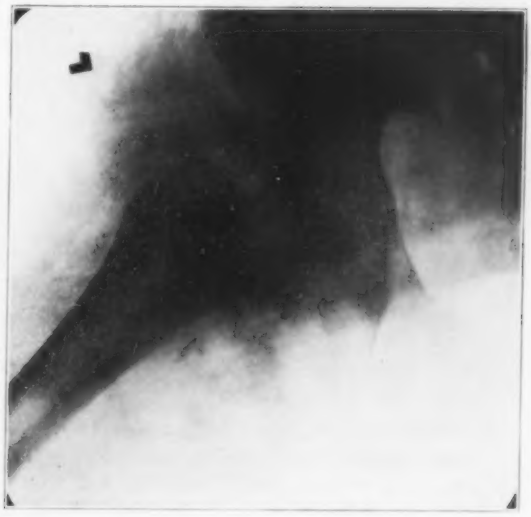

FIG. 4

Same girl corrected in plaster.

FIG. 5

Perfect result after six months of fixation in corrective and six months of free use.

CASE 4. M. S. 1923. Came to the Children's Hospital in February, 1923, at the age of eleven. She was a fat, dull girl, who had always been perfectly healthy. There was no history of rickets. One year before entrance she began to have attacks of pain in right hip, knee, and leg. She would limp for several days and then get better. Since July, 1922, she has been limping all the time. Three weeks ago she slipped on the stairs and fell three steps and after that could not walk.

Examination shows eversion of right foot. There is apparently some swelling of the right hip. Motion of the hip causes pain and there is tenderness over the hip joint. There is one inch of shortening. The roentgenogram showed a marked slipping of the apiphysis, which was corrected under an anesthetic, and the patient put up in full ebduction.

This case evidently represents the typical gradual slipping of the epiphysis with acute injury causing further displacement. The pain and soreness of the slip took an extremely long time to disappear, and it was not thought wise to allow this patient to walk for nine months. She was then gradually allowed up and has now regained normal use of the joint.

CASE 5. W. 1921. First seen in March, 1921, at the age of seventeen years. Two years ago, during the summer vacation, he was thrown from a horse several times, each time bruising his left hip, but not severely enough to lay him up at any time, although he had some pain and a limp, but never any night pain. He has been treated off and on since then with belts, etc., by osteopaths and has continued to limp, but has had only occasional pain. There is one-half inch of atrophy of left calf, and left leg is one-half inch shorter than right. External rotation and abduction limited to 10 degrees. No spasm. Roentgenogram showed moderate downward displacement of the epiphysis with a coxa vara resulting from the bridging of bone across the epiphyseal line to the lower border of the neck. Because of the acute symptoms this patient was put to bed for three months, but the hip was not manipulated. This apparently gave time for further solidification of the bone and the patient, now entirely without limp or symptoms, is in a military school.

CASE 6. C. H. 1922. Ten years old. Seen in October, 1922. During the past summer, the child has complained of pain in the left leg and soreness in the left hip. There is no history of injury. Two months ago she began to limp, but had no night cries. Measurements of the legs and thighs were identical when seen. Roentgenogram showed very slight slipping of the epiphysis, and the hip was immediately manipulated and put up in full abduction on October 25, 1923. She was a particularly fat child, of an unwholesome appearance, and poorly balanced mentality. An older sister was of the same type exaggerated. This child was kept in bed in plaster for four months and was actively treated with thyroid and somewhat with pituitary. The general condition and weight improved considerably.

At the end of four months the plaster was removed and she was kept in bed with active motions and massage and very gradually allowed to get up on crutches, with the result that in June, 1923, she was doing everything normally, with no signs of recurrence of pain in the slipping, and the roentgenogram showed a slight over-correction with good bone formation.

CONCLUSION

Coxa vara adolescentium is a distinct entity. It consists of a disturbance of the nutrition of the epiphyseal line of the upper end of the femur.

It results in various degrees of coxa vara if it is not properly treated. The deformity is due to weight-bearing in heavy children, which causes a displacement of the head through the giving-way of the poorly functioning epiphyseal line. The poor functioning is probably due to some endocrine disturbance and not to rickets or trauma. If the condition is taken early, reduction of the displacement can be obtained, and if this reduction is maintained long enough, complete anatomic restoration and perfect function are possible.

DISCUSSION

Dr. Reginald Sayre, New York City: I think there is no question that these cases that Dr. Kidner has just described are an entity by themselves. The last cases he showed seemed to me to be more of the traumatic kind. They did not look like the roentgenograms of the early cases where the epiphysis has slipped over on the neck very much like a tallow candle in July. In most of these pictures I have seen and from what I have seen in my own pictures there appears to be a little curve in the neck just distal to the epiphysis. The neck appears to be curved on itself, as it gradually slips off and off. In one or two cases which I have seen, where roentgenograms have been taken, the condition was not noted by those who had seen the picture, and the report of a normal joint was given. If you examine them carefully you can see this little curve just at the epiphyseal line, which was quite apparent when the case was photographed some months after.

I believe that the suggestion of correcting this deformity by maximum abduction is correct, though in a good many cases I believe by traction at a right angle that you get a result just exactly as well as by immediate reduction and immobilization. I have a number of cases where by gradual traction in that way the epiphysis appeared to slip back into normal position. The traction must be kept that way for a long enough period of time to have the bones solidify. I believe, in addition to the pituitary and in addition to the thyroid which he uses, lime water is a good thing. I imagine that it hastens the solidification of the other bones. Though they are not the ordinary kind of rickets, I have fed a great many of them on small doses of elixir of phosphorus, giving it two weeks and stopping a week, and then giving it for another two weeks, and so on. If these cases are not kept from weight-bearing there undoubtedly occur very disfiguring deformities in a great many instances. A little later on some of these patients grow to very huge size. At the present time I have a boy whose feet look like acromegaly, but his hands are small, and although he is fourteen years of age he is 6 feet ¼ inch tall, and by the time he is sixteen I think he will be a giant. The adiposity which the Doctor has described is very evident in all of these cases. My experience differs from his because I find most of it in boys, while he has had girls in the majority. I have had comparatively few girls.

I strongly agree with him in his statement in regard to treatment and in the valuable effect of treatment if applied long enough to get the bones solid.

Dr. Philip D. Wilson, Boston, Mass.: I apologize for undertaking to say anything on this subject. My excuse is a very great interest in this condition, which dates back over a period of several years. I think there are two things to consider: first, the question of etiology, and second, the matter of treatment.

Concerning etiology: It appears certain that endocrine disturbance plays a part. The condition appears typically at the age of puberty, and many of the patients are abnormally fat and present the characteristic appearance of infantilism. However, all of the cases are not of this type, and in them we must suppose a different mechanism. At the Massachusetts General Hospital we have investigated some of these cases from the standpoint of metabolism and found them with a fairly normal metabolic rate. We have tried to find evidence of disturbance in the blood chemistry, but here again our findings have been normal. We made calcium and phosphorus determinations on the blood of some of these patients, and these were within normal limits. I believe that the element of trauma, or the factor of weight-bearing, plays a much greater part than is usually supposed. The upper epiphysis of the femur occupies an intra-articular position and lacks the support of joint ligaments such as the other epiphyses enjoy. If the angle of the neck of the femur is normal, then the pressure of the body weight tends to hold the epiphysis in place. With slight flattening of this angle, a shearing strain is brought to bear, and gradual slipping may occur. Particularly is this the case if the superimposed weight is excessive, or if there is disturbance at the conjugal cartilage, owing either to very rapid growth or lack of endocrine stimulation. Under these conditions a very slight trauma may be sufficient to cause complete displacement, or the epiphysis may be only loosened and then the displacement is brought about gradually by the thrust of the body weight at a later period. Only in this way can I account for the fact that this condition occurs in the hip and in no other region of the body.

In regard to treatment: We have been led to try operative replacement in several of these cases because of failure to obtain complete correction by the Whitman method. Dr. Key has studied a group of cases which had been treated by closed reduction and he finds that this is the rule rather than the exception. Unless the deformity is completely corrected, a condition of joint strain is brought about, and later on this is likely to result in a traumatic arthritis and a painful hip. We have seen this occur in several cases. We now have a series of seven cases in which the joint was opened and the epiphysis replaced. The results thus far, both from the anatomic and from the functional standpoint, have been decidedly encouraging, and I believe we should resort to this method whenever we are unable to correct deformity by operative procedures.

I wish to congratulate Dr. Kidner for calling attention to an important subject and also upon the material which he has presented.

Dr. Frederick C. Kidner, Detroit, Mich. (closing the discussion): Dr. Sayre spoke of the last case I showed appearing to be a traumatic case. I daresay it was, but the boy himself did not know he had had any traumatism, nor did his family. He had no sudden onset of limp and it was therefore difficult to make a diagnosis of traumatic epiphyseal slipping.

As Dr. Wilson says, I do not know that this condition always occurs in these fat, heavy types of children, but I think it does. We have been over the metabolic rate and have not been able to draw any conclusions from it. I wish in his next case he would take out a piece of the epiphysis and get a pathologic examination of it.

DIAGNOSIS AND TREATMENT OF BENIGN CYSTIC AND FIBROCYSTIC DISEASES OF BONES

A Report of Five Cases*

BY FRED A. JOSTES, B.S., M.D., ST. LOUIS

From the varied opinions expressed in the literature regarding the etiology, the classification, and the treatment of benign bone cysts, it is quite evident that the subject is still open for discussion. In view of this fact, it was deemed permissible to report the following cases of this interesting condition. However, before reporting these cases it seems advisable to discuss some of the earlier as well as the more recent literature covering the above mentioned phases of the subject.

Not until 1876 was the first bone cyst described. And this cyst of the humerus was discovered by Virchow[1] only by accident at post-mortem in a patient of 54 years.

Various theories have been expounded concerning the etiology of bone cysts. Because of the fact that small islands of cartilage were found free in the fluid contents of the cyst, Virchow believed that this condition of the bone resulted from a dissolution of a chondroma or a cartilage rest. This theory was accepted for a long period of time, but at present it does not seem very likely, as shown by Bloodgood.[2]

Trauma has also been given as a cause for the development of bone cysts. This theory is perhaps a result of the fact that in most cases the first symptoms are noted after a trauma of some sort; also that most cases are first recognized after a fracture, the result of trauma, has taken place. Bech[3] is an advocate of the theory that trauma plays a part in the origin of these cysts. Lang's[4] microscopic studies confirm the theory that a traumatic hematoma is the first factor in the development of a solitary cyst in a bone.

Beneke[5] also tried to prove this theory on the basis of a hemorrhage into the bone, which because of some peculiarity is not absorbed or organized. Manchet and Le Gac[6] protest against the traumatic origin, inasmuch as all their cases showed fully developed cysts only a very short time, two to three days after the trauma. Faulty metabolism has been given as a cause for cyst formation by McCrudden[7] in some of his experi-

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mental work. His theory is based on experiments in which animals were deprived of calcium salts. There was no decrease in calcium output, but after a time bones of the animal softened. This is believed to be one of the factors leading to the formation of fibrocystic and cystic lesions in bone.

As to the classification of bone cysts, the writer believes that this problem is best handled by Bloodgood. Because of the great variety of lesions, this classification needs necessarily to be a large one. An attempt will be made later to classify the cases to be reported according to Bloodgood's outline of benign bone cysts, since the cases reported here are limited to this type of lesion. The outline of benign cysts only is as follows:

1. Single cyst, bony shell, no connective tissue lining.
2. Cysts with a definite connective tissue lining, varying as a rule from 1 to 2 m.m.
3. A small cyst or cysts in a solid mass of ostitis fibrosa.
4. No cyst, but bone shell filled with a solid mass of ostitis fibrosa.
5. Multilocular cysts.

At present it is generally agreed that the proper treatment for cystic disease of the bone is everything but radical. Radical resection was done in many cases needlessly when simple curettement and rest would have led to a good result. In some cases rest is the only requisite. Other cases fracture spontaneously and then heal. It is the writer's belief that curettement should be done before fracture takes place if the condition is diagnosed: thus one avoids the dangers of spontaneous fracture. In support of the conservative treatment, Lotsch[8] proves by his results that radical resection of bones for cystic lesions is entirely unnecessary. He shows new bone formation in cases ten days after simple curettement.

Baccarini[9] put forth the theory that cyst formation in bones was due to repeated hemorrhages into the bone, thus prying apart the lamellae. This sequence, he says, may occur from trauma, but more often it is the result of some toxic or developmental anomaly of the artery wall. He, therefore, believes that our modern treatment of curetting removes the altered bone tissue and the abnormal vessels, leaving a clean cavity to fill up with normal compact bone.

Case 1. M. W. Female, white, age 10. Hospital No. 9210 C. and 9827. The patient was first admitted to the hospital February 16, 1914, because of pain in right upper arm. In the roentgenogram an expanding

process in the upper third of the humerus was discovered. Advised to report from time to time, but this was not done.

FIG. 1

CASE 1. Roentgenogram taken September 30, 1915, showing fracture through the cyst.

Readmitted to St. Louis Children's Hospital September 30, 1915, complaining of a painful right upper arm. There was false motion in the

upper third of the humerus, with a fusiform enlargement. The roentgenographic (see Fig. 1) note of the same day reads as follows: "Upper third of right humerus has been enlarged by an expanding process. There are numerous darkened areas separated from each other by irregular defined

FIG. 2

CASE 1. Roentgenogram taken October 18, 1915. Bone graft in place. Some formation of new bone.

lines of osseous structure. The cortex surrounding the expanded portion of the bone is extremely thin. Between the normal bone and this cystic structure there is an area of increased bone density. Just above this is a line of fracture."

Roentgen-ray diagnosis: "Cystic disease of the upper metaphysis of the right humerus with pathological fracture."

October 3, 1915. At operation the upper end of the humerus was enlarged. The cortex was thin and easily broken. There escaped a

FIG. 3

CASE 1. Roentgenogram taken March 10, 1916. Shows almost complete obliteration of the cyst.

dark hemorrhagic material suggesting sarcoma. On close examination, however, of the lesion it was found to be a cystic cavity with an indefinite

lining. The cavity was curetted. A bone graft taken from the fibula was mortised into the shaft below. October 18, 1915 (see Fig. 2). Roentgenogram showed graft in place with good alignment of the fragments, with the formation of considerable bone even at this early date. October 3, 1916. Roentgenogram shows complete obliteration of the cyst. (See Fig. 3.)

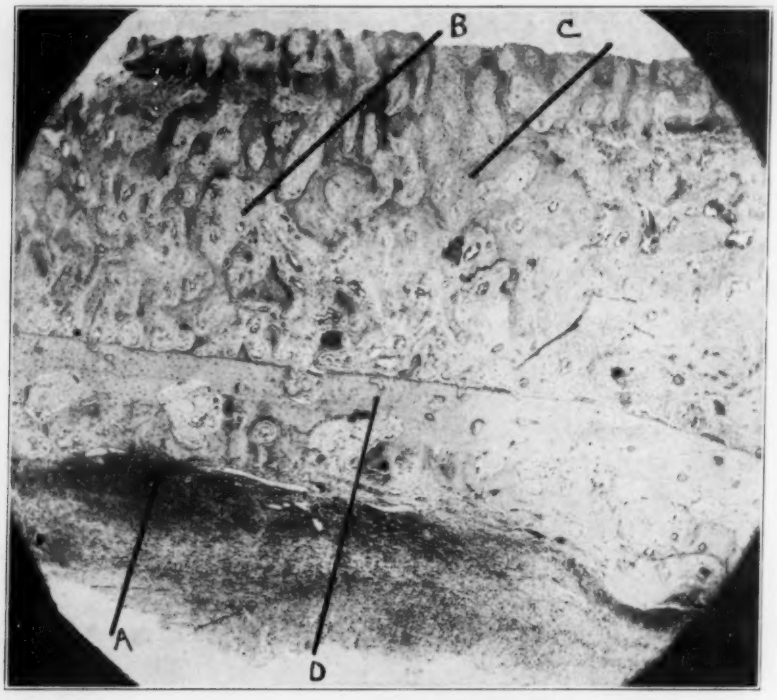

FIG. 4

CASE 1. Surg. Path. No. 1142. Low power. Photomicrograph. Case of ostitis fibrosa cystica of humerus showing section of the shell-like cyst wall.
A. Fibrous tissue lining of cyst.
B. Fibrogranulomatous tissue.
C. Bone trabeculae.
D. Dense bone.

Gross Pathology. The specimen consists of numerous pieces of bone, the largest about 1x3 cm., and many small bits of dark soft tissue resembling granulation tissue. The pieces of bone are irregular and covered on one side by tissue similar to old granulation tissue. Microscopic

examination. The tissue taken from the bone cavity consists of blood clots and granulation tissue. The lining of the cavity is made up of a very

FIG. 5

CASE 2. Showing areas of diminished bone structure above and below the fracture line. Another dark oval area is shown 15 cm. down the shaft of the femur.

thin layer of fibrous tissue. There is some new bone formation, both subperiosteal and subendosteal. (See Fig. 4.)

CASE 2. Hospital No. 13636. M. D. Female, white, age 14. Admitted to St. Louis Children's Hospital, January 8, 1919, complaining

FIG. 6

CASE 2. Roentgenogram taken November 7, 1923. Shows almost complete obliteration of cyst first appeared and partial obliteration of cyst last explained.

of painful left hip. Onset of condition in September, 1916, following a fall. No apparent disturbance in hip. No roentgenogram taken at the

time. On January 8, 1919, slipped on a wet floor and the left leg was doubled under the body. There were the usual signs of fracture of the femur about three inches below the great trochanter. Roentgenogram taken at this time revealed a generalized mottling of the upper third of the shaft of the femur with a pathologic fracture just below the great trochanter. The fracture was treated in the usual way. Wassermann test negative. No other bones of the body were involved, as shown by the roentgenograms.

On March 6, 1920, the roentgenographic report is as follows: "There are dark areas both above and below the old fracture line, which show a diminished amount of bone structure. At a point about 15 cm. down the shaft of the femur there is a dark oval area. The cortex of the entire femur is very thin." (See Fig. 5.)

September 14, 1922, there is no apparent improvement.

At operation July 15, 1922, the shell of bone just over the fracture line was readily perforated, for it was but one-half cm. in thickness. The cyst cavity was about 5 cm. in diameter. It contained a clear yellow fluid, which was rather thick in consistency. The cyst was lined with connective tissue, which gave a smooth feel. With a curette, all the lining was removed and the cyst swabbed with phenol and alcohol. The leg was fixed in plaster.

January 29, 1923, the cyst further down the femur was explored. The cavity was about 2½ cm. wide and 4 cm. long. The lining was very smooth and peeled away with a curette with comparative ease.

Fig. 6. Roentgenogram taken November 7, 1923, or fourteen months after first operation, and eleven months after second operation, shows almost complete obliteration of cyst first explored and partial obliteration of the one last explored.

Pathology. The microscopic examination of the specimens removed at both operations showed an increase in fibrous tissue in the bone itself and a connective tissue lining of the cyst about 2 cm. in thickness.

February, 1924. This patient came in complaining of a painful right foot. There was some swelling of the foot; no local tenderness. A roentgenogram, Fig. 7, revealed an expanding process of the second right metatarsal, evidently a cyst formation. No other lesions were found in the skeleton. The femur showed a marked improvement.

The ultimate result in the case is difficult to state at this time. If this disease becomes general the prognosis is not very good; if it remains limited to its present involvement a good result can be assured. From its distribution one would take this to be the type of generalized osteitis

fibrosa cystica described by Von Recklinghausen.[10] The absolute pathology of this case, however, does not meet with that of the cases described by Von Recklinghausen.

CASE 3. G. R.; at present, February 2, 1924, a patient in Barnes Hospital. Colored, male, age 16. Entered with complaint that "left leg is out of place." Onset of condition June 21, 1917. While sliding for

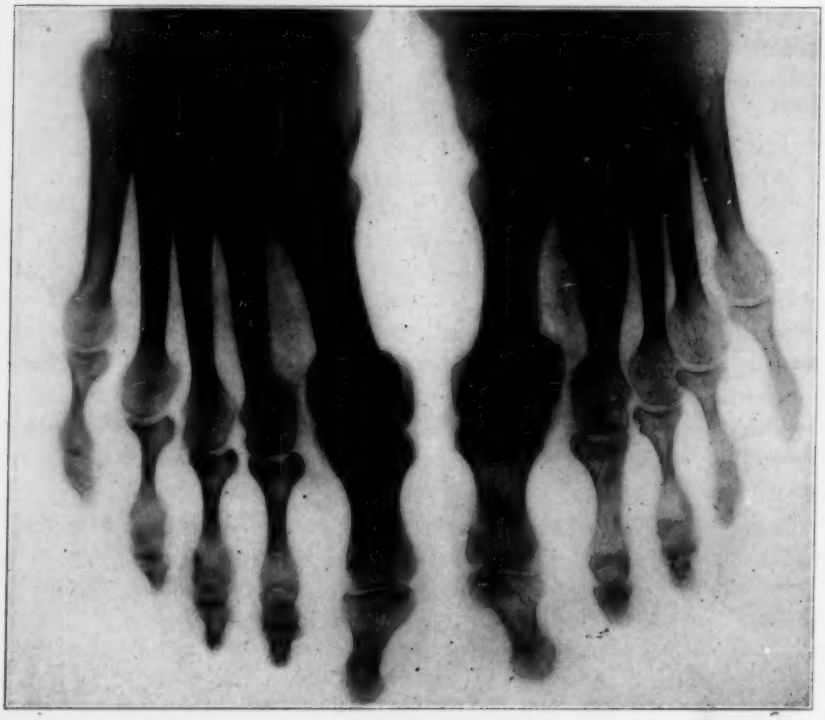

FIG. 7

CASE 2. Roentgenogram taken February 8, 1924, showing expounding process of second metatarsal.

third base in a baseball game patient fractured his left hip In traction for one month; in plaster spica for another month. Does not know what roentgenogram taken at the time showed. In 1918, pain again in hip; 1921, hurt his leg again while jumping. In bed for one week. Gradually since that time leg has become shorter and more deformed. Physical ex-

FIG. 8

CASE 3. Roentgenogram taken December 29, 1923, showing large areas throughout femur of lesser bone density.

amination showed a visible deformity of left upper thigh, with 5 cm. shortening of left leg. No false motion of hip. Marked prominence just

distal to what would appear to be the great trochanter. Throughout the shaft of the femur there were numerous large elliptical dark areas, chiefly within the marrow cavity. The cortex was intact, but very thin. Similar scooped-out areas could be seen throughout the region of the trochanter. (See Fig. 8.)

January 11, 1924. At operation a very thin shell-like cortex was found to contain a large mass of dense fibrous tissue. This tissue was

FIG. 9

CASE 3. Surg. Path. No. 7231. Low power. Photomicrograph. Case in which the bone shell was completely filled with soft tissue.
A. New bone.
B. Fibrogranulomatous tissue.

white and glistened on the cut surface. The cyst was curetted and in an effort to correct the deformity shown in the roentgenogram a bone graft from the tibia was mortised into the distal fragment of the shaft of the femur.

On microscopic examination there is shown in Figs. 9 and 10 separation of the newly formed bone trabeculae by a fibrogranulomatous tissue.

Apparently these trabeculae have not ossified. The fibrous tissue is made up of long and short spindle-shaped cells, with here and there an infiltration of round cells.

CASE 4. B. E. Hospital No. 1930 S. Female; age 11; white. Admitted to St. Louis Children's Hospital April 23, 1923, with complaint of pain in left hip. Onset of pain, 1920. Noticed first while riding coaster wagon, which was propelled with left foot. Mother noticed limping at

FIG. 10

CASE 3. High power. Photomicrograph.
A. Long and short spindle cells.
B. Osteoblasts lining newly formed trabeculae.
C. Nest of osteoblasts.

this time. On physical examination left leg 8 cm. shorter than the right. No limitation of motion.

(See Fig. 11.) There is an expanding intramedullary bone process in the upper end of the metaphysis of the left femur. The cortex has been markedly thinned and the width of the femur at this point is greater in comparison with the opposite side. The head of the femur, as well as the great trochanter, are not involved. The lesion is confined to that portion

of the femur below the epiphyseal line. There is a decrease of density throughout, which is suggestive of striations, giving the whole a pocketed appearance. The patient was put under observation for a few months. May 15, 1923, patient returned with an apparent fracture of the neck of the femur on the left.

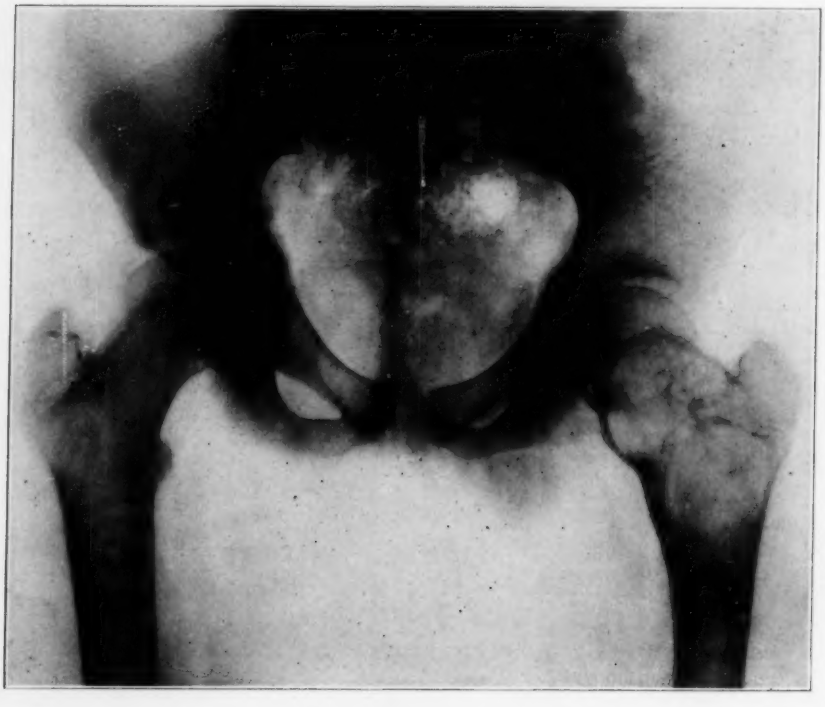

FIG. 11

CASE 4. Roentgenogram taken April 23, 1923, showing an expounding intramedullary bone process in the upper end of the femur.

On radiographic examination there was a fracture of the left hip coursing through the anatomic neck of the femur just forward of the great trochanter. May 17, 1923. At operation, three inches of the upper shaft of the femur and the neck were found cystic. The cortex was shell-like and filled with gelatinous material. The cyst was lined with connective tissue. The cyst was curetted and swabbed out with iodine; treated otherwise as ordinary fracture of neck of femur.

Pathology. The lining of the cyst measured about 3.4 mm. in thickness. The lining was made up of long and short spindle-shaped cells in a fibrinous net work. There was small infiltration of round cells. No evidence of ossification. (See Figs. 12 and 13.)

There has been a marked improvement since operation. A roentgenogram taken December 12, 1923 (see Fig. 14) showed almost complete

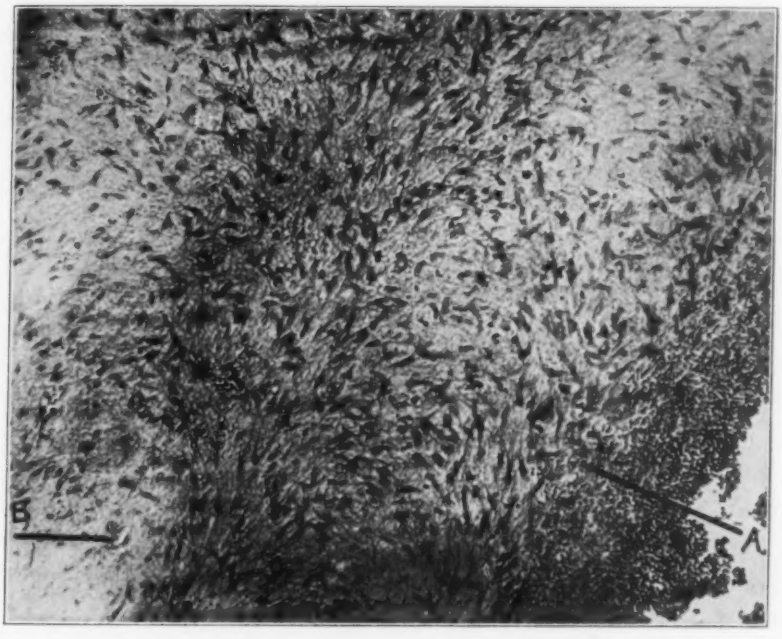

FIG. 12

CASE 4. Surg. Path. No. 6498. Moderately high power. Photomicrograph. Case of osteitis fibrosa cystica of femur. Apparently no new bone formation.

A. Inner border of cyst, some slight hemorrhage.
B. New blood vessel.

obliteration of the cyst by new bone formation. The patient is in good health at present and is permitted to lead the life of a normal child of her age.

CASE 5. L. C. Female; age 14, white. Hospital No. 18053 S. Admitted to St. Louis Children's Hospital January 6, 1923, with the complaint of pain in left hip. In the winter of 1920 the patient fell while skating. Has noticed a tender spot on the left hip and has limped since.

In August, 1921, fell from bicycle. Came to the out-patient department of Washington University Medical School, October 3, 1921. A roentgenogram (see Fig. 15) at this time showed marked bone atrophy throughout the left ilium, with numerous large and small darkened areas of decreased bone density. The other bones of the body showed no involvement. There is, however, a curvature of the spine.

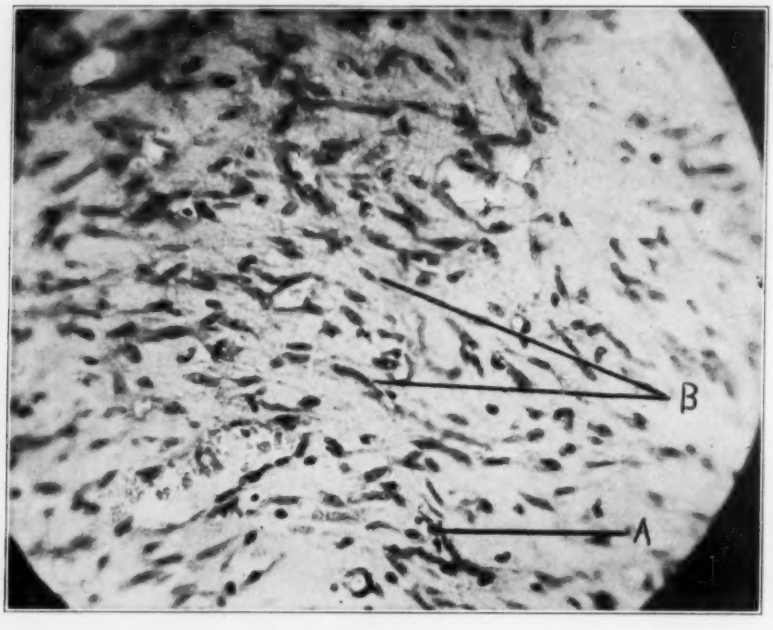

FIG. 13

CASE 4. High power. Photomicrograph.
A. Round cell infiltration.
B. Long and short (fibrous tissue) spindle cells.

At operation, January 17, 1922, when the ilium was explored and tapped, it had a shallow sound. The cortex was shell-like and easily broken into. Several multilocular cavities were found, from which bloody granulation-like substance was removed. The entire lateral and anterior wall of the cyst was crushed. There was no lining made out at operation.

Gross Pathology. The specimen consists of many shell-like fragments of bone, the thickness of which is not more than .2 cm. On section, the bone has very little cellular definition and there is marked disintegration

of the matrix, which is very loose, with space between its strand-like structure filled with non-calcified cellular tissue. There was apparently no lining of connective tissue in this case.

Following the operation there was a discharge of sero-sanguinous fluid for a period of three months. At the present time there is no com-

FIG. 14

CASE 4. Roentgenogram taken October 12, 1923, showing almost complete obliteration of cyst by new bone formation.

plaint on the part of the patient. She is apparently in good health. However, the patient came in for routine observation on December 12, 1923, and the roentgenogram showed apparently no obliteration of the cyst; in fact, if anything, an expansion. Since there is no complaint, the

patient will be permitted to go on without further operation unless symptoms arise which would warrant such a procedure.

According to Bloodgood's classification of benign bone cysts, Cases 1, 2 and 4 in this series may be classified under Group 2, consisting of cysts with a definite connective tissue lining. Case 5, on the other hand, would be classified in Group No. 5, consisting of multilocular cysts without con-

FIG. 15

CASE 5. Roentgenogram taken October 7, 1921, showing marked bone atrophy and mottling throughout left ilium.

nective tissue lining. This is a rare type. Case No. 3 comes under the group classified as bone shells, filling with a solid mass of osteitis fibrosa, or Group 4 in the classification.

The age incidence in this group of cases varies from 10 to 16 years, in agreement with the statement by Mikulicz[11] that this is primarily a disease of adolescence. It has been demonstrated, however, that this disease not infrequently occurs before puberty and also as late as the thirtieth year. Silver[12] reports a series of 97 cases, in which 70 per cent. appear under 20

years of age and 85 per cent. under 30. The youngest known case was in a child 2½ years old. Virchow's patient was 56 years old when the cyst was discovered at autopsy.

As a rule, the long bones are chiefly affected, especially the proximal end of the bones. In this group of cases, the femur was involved three times, the humerus once, and the pelvis once, the metatarsal in one case, secondary to the lesion in femur. This is too small a group of cases from which to draw any definite conclusion, but in a large number of selected cases, Bloodgood and Silver have demonstrated the predilection for the proximal end of the bones, as well as for the long bones themselves.

DIAGNOSIS

In this disease, as is true in most diseases of the bone, no one clinical feature will absolutely lead to a diagnosis. A careful clinical history and physical examination are necessary. The age incidence, the rate of development of the lesion, the lack of pain, fracture, and lastly the roentgenographic examination, are essential in making an accurate diagnosis. Even with all this data, it is not infrequently the case that an exploratory operation is necessary to finally lead to definite diagnosis. A mistaken diagnosis of sarcoma is frequently made. This can be avoided if it be taken into consideration that as a rule a sarcoma is painful, grows rapidly, invades quickly, and frequently invades the epiphysis, all of which a cystic condition does not do. Also in sarcoma, the outline of the bone always appears abnormal and indefinite. Some areas appear entirely translucent. In a cyst, on the other hand, the cortex appears thin, but well marked and regular, and the adjacent epiphyses are normal.

This mistaken diagnosis is most frequently made, as Platau[13] shows, in cases where the shell is filled with a tumor-like tissue, which microscopically would easily be mistaken for sarcoma, giant-cell or spindle-cell as the case may be.

In the literature, there are a number of cases reported in which death followed operation, due to hemorrhage from the cysts. In none of the cases described above was there more than the usual operative hemorrhage. However, in all cases operated upon this factor must be taken into consideration.

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SACRALIZATION OF THE FIFTH LUMBAR VERTEBRA

BY B. H. MOORE, M.D., CHICAGO, ILLINOIS

The question of the responsibility for low back pain looms large in the orthopaedic world at the present time. The fact that there are so many patients with the complaint and that this anatomic region is one in which there are so many and puzzling stresses and strains, renders the question of more than ordinary interest. The French and Italians have furnished the greater part of the literature which is rapidly accumulating on the subject. This paper will by no means settle the question of the rôle that is played by sacralization of the fifth lumbar vertebra in the production of low back pain, but is intended merely as a contributory study.

In this study only cases of true sacralization were considered, for the reason that impingement of the transverse process in the pseudo-sacralization cannot be determined accurately with single roentgenograms, and not enough cases were available for study in which the necessary multiple plates had been taken.

Very elaborate systems of classifying the various abnormal forms of fifth lumbar transverse processes have been devised, but for the purpose of this paper it is sufficient to classify the sacralization as complete and incomplete. Complete sacralization consists of a complete bony union between the abnormal transverse process and the sacrum. Incomplete sacralization shows a well defined joint line between the process and the sacrum. Both forms may be either unilateral or bilateral. The complete bilateral sacralization verges into a sixth sacral vertebra and cannot be distinguished except by the number of other vertebrae present.

This study was made from three standpoints: anatomic, radiographic, and clinical. For the anatomic study, material was examined at the laboratories of Northwestern University Medical School and the University of Chicago. Eighty-seven cadavers and skeletons were examined and sacralization was found in three cases, or 3.4 per cent. The anomaly was unilateral in all these cases. One of the specimens found at Northwestern was dissected and studied. It is presented herewith.

This specimen shows an incomplete sacralization on the left side. The transverse process on this side is of the large butterfly type, while on the right it is about the usual size. The sacralized side shows a definite

joint apparently of the same type as the sacro-iliac joint. The transverse process and the sacrum are connected by a broad band of ligament and the lower portion of the process is connected to the ilium in the same way. From the upper wing of the process there is a thick ligament attaching to the crest of the ilium. On the right side there are two ligaments from the tip of the process to the ilium. The upper is thick and strong and extends

FIG. 1

Dissected specimen showing sacralization on left side. Lumbar nerves in place. Note wedge shape of fifth lumbar body. Also large foramen of exit for fifth lumbar nerve on sacralized side.

upward and backward to the crest of the ilium. The lower is much thinner and attaches to the face of the ilium. There is no ligamentous connection between the transverse process and the sacrum.

The body of the fifth lumbar vertebra is set deep between the wings of the ilium and is asymmetrically placed, being nearer to the ilium on the left. The fifth lumbar body is distinctly wedge-shaped, being thinner on the right side than on the left. There is a slight rotation of this vertebra

to the left. The whole right side of the vertebra appears to have sagged forward somewhat.

The general impression given by the specimen is that the left,—that is, the sacralized side of the fifth lumbar vertebra,—is much more securely anchored than the right. The foramen for the exit of the fifth lumbar nerve on the left side is much wider than that on the right.

FIG. 2

Showing sacralized transverse process. Nerves drawn forward.

The lumbo-sacral angle is somewhat greater than the normal. From the posterior surface there is a failure of union of the spinous process of the first sacral vertebra.

From the pathologic collection at Northwestern, a specimen of unilateral complete sacralization was also obtained. In this there is no trace of a joint visible between the sacrum and the transverse process. There is none of the rotation and sagging of the fifth lumbar seen in the other specimen. The ligamentous arrangement could not be determined,

as this was a dried specimen. Roentgenograms were taken of both of these specimens to confirm the findings.

The feature that impresses us in these two specimens is the apparent solidity and strength of the sacralized side as compared with the other. From its appearance it would seem that it would be less subject to injury and strain than the normal side, though in unilateral sacralization there

FIG. 3

Non-sacralized side of specimen. Note narrow exit of fifth lumbar nerve.

might be a factor of unbalanced strain which might cause trouble. About one-third of the cadavers examined were those of negroes. No case of sacralization was found in these. Mauclaire and Flipo found the condition occurring much more frequently in the skeletons of the lower races than in the European.

In studying the condition from the radiographic standpoint, a series of 1104 plates of the lumbo-sacral region were examined. These were not selected, but were simply the most available back plates. Included in the series were 340 plates from the Children's Memorial Hospital and

the Children's Hospital in Boston. The adults' plates were from the Illinois Central Hospital, St. Luke's Hospital, and Northwestern University Medical School. In the entire series there were thirty-seven cases of sacralization, either unilateral or bilateral, a percentage of 3.35. This correspondence with the percentage found in the cadavers is noteworthy, as it might be expected to be considerably higher on patients who had reason to have roentgenograms taken of their backs.

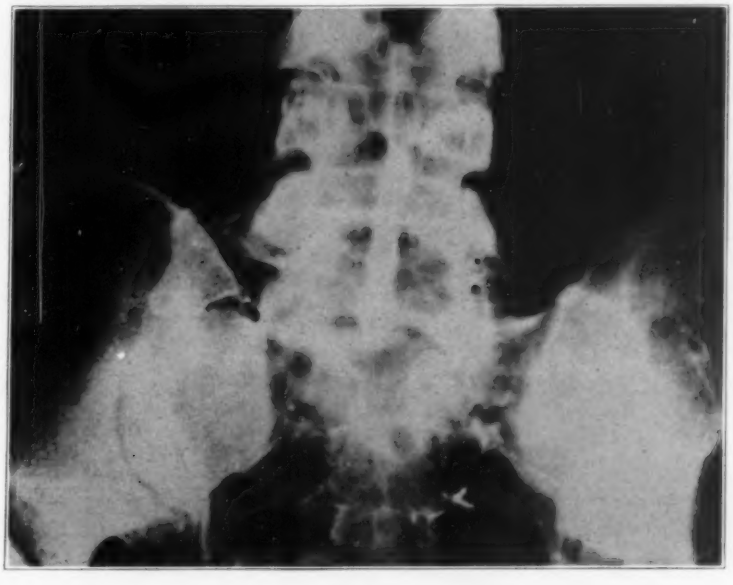

FIG. 4

Roentgenogram of specimen shown in FIGS. 1, 2, 3. Incomplete sacralization.

In the 340 children's plates, there were thirteen sacralizations, a per cent of 3.8. One striking feature of this series is that, of the thirteen who showed sacralization, six had also congenital dislocation of the hip. This is probably of no more significance than the fact that six others had tuberculous spines. The lowest age at which sacralization was shown in this series was five years. Owing to the incomplete ossification in younger children, the appearance is very different from that presented in adults. The body of the fifth lumbar vertebra is not set so deeply between the ilia as in the adult. The tips of the transverse process appear bent down to

meet the sacrum so that the fifth lumbar vertebra with its transverse process has the form of a flattened arch. It is later that the upper wing of the transverse process becomes ossified enough to give the typical butterfly wing appearance.

In this series of 1104 plates, the occurrence of bifid spinous processes of the fifth lumbar and first sacral vertebrae was noted. This occurred

FIG. 5

Roentgenogram of specimen of complete sacralization—unilateral.

in 5.34 per cent. In five cases it was associated with sacralization. The anomaly is nearly twice as common as sacralization. Clinically forty cases were studied, eighteen from hospital records and twenty-two by personal observation. None of the children had any symptoms which could be ascribed to the sacralization. In their cases the roentgenograms were taken for some other condition and the abnormality of the vertebra

was only incidental. Of the remaining twenty-seven adult cases, roentgenograms were taken of seven fractures or other injuries in this region and the sacralization was an incidental discovery in these. Of the other twenty, six had had or were having definite sciatic pains. Of these, three had a bilateral sacralization with a unilateral sciatica, and one with the unilateral sacralization had his sciatic pain on the opposite side. Fourteen of the patients complained of low back pain. All of these but one were laborers,

FIG. 6

Bilateral sacralization in a child. Unilateral congenital dislocation of hip.

doing very heavy work, and all had other factors which might account for the pain, such as infected teeth, tonsils, or sinuses. Four showed definite osteo-arthritic changes of the lumbar vertebrae or sacro-iliac joints in the roentgenogram. In four of these cases operative removal was attempted. In none of them was the removal complete, as shown by postoperative roentgenogram. These were cases of true sacralization, cases of abnormally long transverse processes having shown complete removal. Yet in all four cases which were operated on the pain was relieved rather strikingly. This is difficult to account for.

FIG. 7

Bilateral sacralization. Complete on one side; incomplete on the other.

CONCLUSION

True sacralization occurs in about 3½ per cent of cases, both as seen in the cadaver and in the roentgenogram. In about half of the cases, there are symptons associated with its occurrence which may be related to it, but which are not accounted for by the anomaly alone. Anatomically and architecturally, the sacralized formation appears stronger and more able to resist strain than the usual arrangement.

OSTEITIS DEFORMANS (PAGET'S DISEASE)

Pathologic Fracture with Perfect Consolidation

BY PHILIP LEWIN, M.D., F.A.C.S.

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Since a paper on this subject by the writer appeared in this Journal in 1922, few articles have appeared.

There are recorded about two hundred fifty-one cases of osteitis deformans. Included in this number are about fifteen cases of pathologic fracture. Up to 1908 Schirmer was able to collect five cases of pathologic fracture. To this number should be added:

Martini, Kuster, Israel, Sommers, Auffret, Carman and Carrick, and Lewin, one case each, and LeWald five cases, making seventeen in all. It is highly probable that some of the reported pathologic fractures of Paget's disease were cases of true osteitis fibrosa cystica. J. A. Smith of England reports one case of traumatic fracture of the tibia. After twelve weeks the patient stood up and suffered a refracture which united after a very long period.

I have been unable to find any reference to consolidation of fractured bones the seat of osteitis deformans, except the statement of LeWald that rapid and complete union occurred in two of his cases. In a recent personal communication he describes a spontaneous fracture of the femur in a woman of forty. The fracture united with abundant callus. In this case the disease was confined to the one bone. He believes that Paget's disease is in some respects the antithesis of acromegaly and may be due to some pituitary gland disturbance and should be so classed and treated. He opposes the theory that syphilis is the cause. Ely reports one case of subtrochanteric fracture of the femur with "no sign of any attempt at union."

The present case is, therefore, of particular interest, firstly from the standpoint of bone pathology and repair, it being the third case on record of pathologic fracture with union; and secondly, from the point of view of medication in metabolic bone disturbance.

Da Costa and others state that the occurrence of fractures is infrequent and probably no more common than in any other disease. Its occurrence has been noted in a few instances, of which Auffret's case is notable because of the number—four in all—in the same individual. The patient, aged 45, manifesting the multiple bone involvement of Paget's disease when he came under observation, gave a history of fracture of the anterior tuberosity of the tibia at 35 years, fracture of the left humerus at 39 years, fracture of the left forearm shortly afterward, and fracture of the left humerus a second time at 42 years, in each instance apparently following a trivial injury. The first fracture occurred about the time the deformity was first noticed in his legs. Fractures have been described as preceding the development of the disease in the same and other bones during the course of the disease in the affected and non-affected bones, and it is difficult to argue *post hoc propter hoc* in view of its infrequency. The statement of Meunier that "the bones in osteitis deformans are fragile due to the loss of organic matter and an accompanying increase in salts, especially calcium phosphate," is of interest in this connection.

The conclusion may be drawn that in osteitis deformans there has been a substitution of inorganic matter for organic matter in the bones. A certain quota of the highly sulphurized substance of the organic matrix may have been replaced by a calcification process. This of itself would lead to a gain of calcium and an accompanying loss of sulphur, which have both been demonstrated chemically in their experiments.

Carman and Carrick state that spontaneous fracture in Paget's disease is considered rare by most observers. In one of their cases a pathologic fracture occurred through a sarcomatous tumor in the upper third of the femur.

In a study of fourteen cases of Paget's disease, LeWald found spontaneous fractures in four. He believes that fractures are not unusual in Paget's disease, and if they occur, will probably unite. Cases are not prone to develop malignancy, and the face bones may be involved.

Hurwitz calls attention to the fact that a large number of cases have been incorrectly described as Paget's disease. He states that the occurrence of spontaneous fractures is almost pathognomonic of osteitis fibrosa.

In fourteen cases of Paget's disease Abbe found four with jaw complications. He operated upon two and obtained excellent results.

CASE REPORT

History. M. V. White; female; age seventy-four years; entered Evanston Hospital under the care of Dr. M. C. Hecht, November 25,

1923. A few hours before admission, while walking across the floor of her room, she stumbled on a rug and fell to the floor. She was unable to rise and noticed that her right thigh was deformed, and she suffered severe pain. There were no contusions of the skin and it is undetermined whether the pathologic fracture was cause or effect. It is highly probable that she suffered a pathologic fracture which caused her to fall.

FIG. 1

Roentgenogram showing fracture of femur at junction of upper and middle thirds.

Physical Examination. The patient bears a marked facial resemblance to Paget's original case of osteitis deformans, although of opposite sex.

Head, neck, chest, and abdomen examinations normal.

Extremities. Marked outward and anterior bowing of the left thigh.

At the junction of the upper and middle thirds of the right thigh is a mass due to overriding of bone fragments. Crepitus and false point of motion are easily obtained. Not much pain on movement of the fragments.

Roentgenograms by Dr. E. L. Jenkinson "reveal a fracture of the right femur at the junction of the middle and upper thirds with upward, inward, and forward displacement of the lower fragment. The lower two-thirds of the fractured femur and the entire left femur, together with

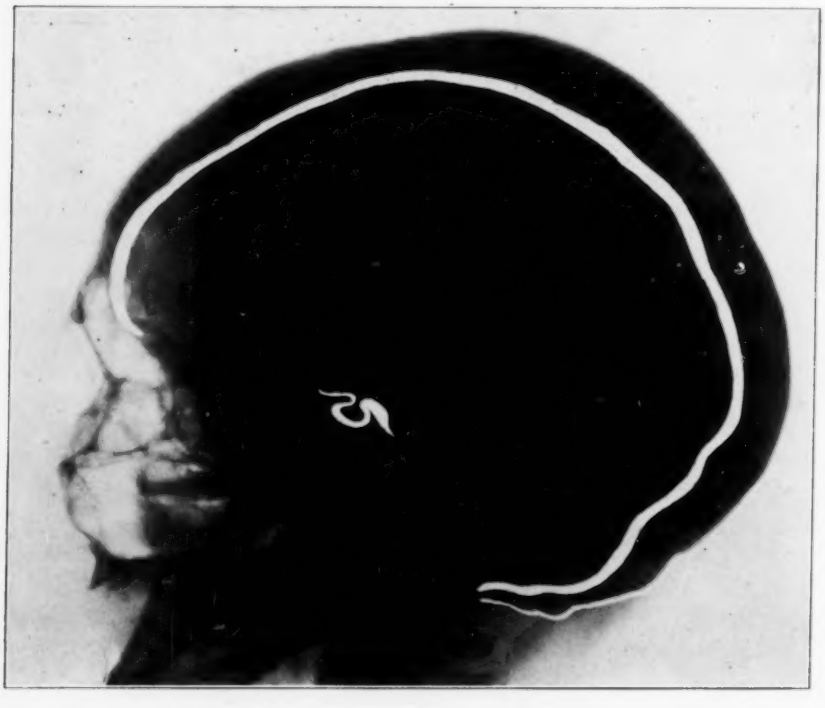

FIG. 2

Skull of same patient showing fuzziness or "pickaninny wool" appearance.

the skull, are typical of Paget's disease. There are marked changes in the distal fragment. The shaft of the bone is markedly widened and there are a great many bands of thickening which extend downward from the level of the fracture. I believe the fracture is due to pathologic changes in the bone. There are definite changes involving the vertex of the skull, showing both rarefaction and osteosclerosis. The parietal and occipital bones are greatly thickened. I believe it is a case of Paget's disease."

Buck's extension was immediately applied. On November 26, 1923, an attempt to reduce the fracture under nitrous oxide anesthesia was unsuccessful. Very little force was used because of the osteitis.

On November 27, 1923, the writer was asked to see the patient, and he applied a plaster of Paris spica, using the Hawley traction table. Partial reduction was accomplished. The patient was able to walk with the

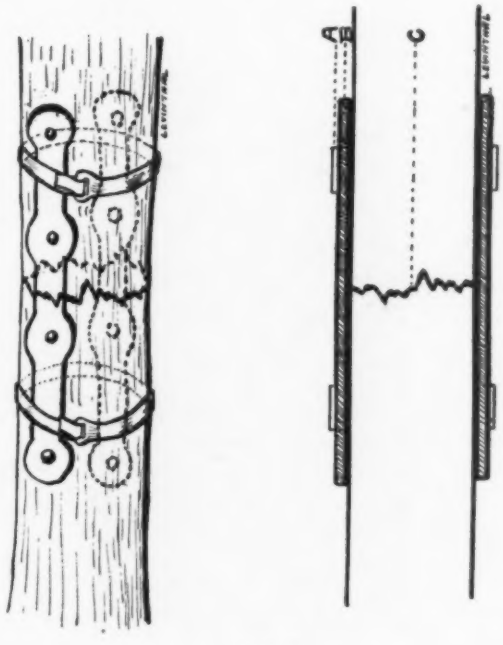

FIG. 3

Diagrammatic representation of mechanical means of retention of fragments. A—Parham-Martin band. B—Lane plate. C—Point of fracture.

aid of crutches in a few days. Because of incomplete reduction of the fragments operation was advised, and on December 13, 1923, was performed, with Drs. Hecht and Loewe assisting. The usual bone grafting or plating operations were contraindicated by the nature of the bone affected. Reluctantly, therefore, two Lane plates were applied and held in place by two Parham-Martin bands. (Screws could not be used.) A spica cast was then applied.

The following medication was given:

1. Phosphorized Cod Liver Oil ℥ii t.i.d.
2. Thyroid Extract gr. ¼ t.i.d.
3. Calcium Lactate grs. XV t.i.d.

FIG. 4

Roentgenogram showing consolidation of fracture.

The diet included large quantities of milk and fresh vegetables and fruits. Direct sunlight was utilized when available.*

Because of the low grade infection (which probably stimulated osteogenesis) all metal was removed on January 8, 1924, without changing the cast. Dakin-Carrell treatment was instituted with excellent result and she was discharged from the hospital January 27, 1924.

* In view of the fact that the writer had under his care at that time a structural iron worker with a fractured femur which was developing good callus, Imbert's fracture serum was considered, but not administered.

On March 9, 1924, the cast was removed and a caliper splint with a pelvic attachment supplied. This allowed locomotion while using crutches. At the present time the patient can walk short distances without the brace or a cane.

SUMMARY

In conclusion, the writer begs indulgence for the use of "hardware" in the operation of this case. He believes the end justified the means: viz—the perfect consolidation of a pathologic fracture in a bone having Paget's disease.

Note. On the basis of the results of the careful metabolic studies of Da Costa, et al., viz—a pronounced retention of Ca. P. and Mg. and a loss of S., it seems rational to administer the first three and eliminate from the diet the fourth, and the case here reported is added evidence in favor of their contention.

Comment. I believe the medication was very important in producing bony callus. In discussing this case with Dr. J. C. Bloodgood, he stated that it was the only case of pathologic fracture with union of which he had knowledge.

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CARIES OF THE NEURAL ARCH OF A VERTEBRA*

BY J. B. BARNETT, STANMORE, MIDDLESEX, ENGLAND

The case I propose to describe is of interest, partly because of the extreme rarity of a tuberculous sequestrum of a spinous process, and partly because of the phenomena which followed its removal.

The patient, Rose S., had an abscess form in the left groin five years ago, when she was fourteen years old. She was admitted to a large general hospital in the Provinces, and the abscess was incised and drained. There is no record of any pathological examination of the pus having been made. Later other abscesses came up in both inguinal regions and were incised as they appeared. Pain was entirely absent except when an abscess was actually forming, and it is said that other symptoms and signs were not evident. Her family history as regards tubercle is good, but her circumstances were poor. A diagnosis was made of "Tubercular glands of the groin and sinuses of unknown origin."

After two years In-Patient treatment she was transferred to a hospital near London specializing in cases of surgical tuberculosis. Here, in June, 1922, when she was seventeen years of age, an abscess was noticed over the upper dorsal spine. It was opened, and a chronic sinus remained. Also she had a transient discharge from one ear, a chronic cough, and a chronic diarrhoea, which only cleared up after some months.

In June, 1923, she was admitted to the country branch of the Royal National Orthopædic Hospital at Stanmore, under Mr. Elmslie.

On admission her temperature was hectic, and she had a discharging sinus over a rigid, slight, upper dorsal kyphosis. There was nothing abnormal found in the urine, and no evidence of amyloid disease. No definite focus of tubercle in the lungs was found. Bare bone could be felt on probing the sinus in the back, and a lateral skiagram demonstrated disease of the laminae of the third dorsal vertebra. The sinuses in the groin were healed, but the patient looked and felt very ill.

Considering her poor general condition it was thought wise to postpone operation. She was treated in a plaster bed, and her back exposed to the sun, while the vertebral column was steadied by an anterior plaster

* From the Royal National Orthopædic Hospital, London. (Mr. R. C. Elmslie's clinic.)

shell. Under this treatment the hectic flush disappeared, her temperature dropped to a normal range, and she put on weight.

Operation was performed on October 26th. The dorsal sinus was excised through an elliptical incision, and beneath there lay the sequestrum of the third dorsal spinous process on a bed of granulation tissue. The latter was gently curetted, the cavity swabbed out with Brilliant Green, and the wound closed without drainage. She was nursed on her plaster bed.

An hour later the patient suddenly collapsed. The temperature dropped to 95°, the pulse was 140 to the minute, there was girdle pain at about the level of the nipples, and complete paralysis and anæsthesia below. It was thought that intradural haemorrhage had occurred. The head of the bed was raised on blocks, and the usual treatment for shock commenced.

The patient's further progress was marked by an extraordinary variation in the sensory and motor disturbances. According to Osler and Macrae this is not uncommon in cases of intradural bleeding. The alterations were noted with the minimum of disturbance to the patient, day by day, as they occurred, and doubtless a neurologist would find errors and omissions. Some of the more striking manifestations may be mentioned. For instance, the second day after operation sensation had returned over the whole area below the lesion except for epicritic anaesthesia over the left side of the abdomen. But the next day epicritic and protopathic sensation had completely disappeared from the abdomen. On the fifth day sensation over the whole body was normal, whereas the day following, there was complete epicritic anaesthesia from the nipples down. The behaviour of the reflexes was equally variable. The knee-jerks, exaggerated on the eighth day, could not be elicited on the ninth, and yet on the eleventh day a patellar clonus was present. The most constant was an extensor plantar reflex, which persisted for three months. Voluntary movements of the legs returned on the fourth day, and were lost the day after. Incontinence of urine was not present after the fourth day.

Motor power and normal sensation were completely regained within three months, and the patient is now about to get up in a light support.

The sequestrum consists of the spinous process of the third dorsal vertebra, together with the spinous ends of the laminae. The spinous process is noticeably short for a dorsal vertebra, and suggests, I think, that the disease commenced as an epiphysitis of the spinous process, with exfoliation or destruction of the epiphysis. The bone is pitted and eroded in the manner characteristic of tubercle with a secondary septic infection,

but the sequestrum appears to be much harder and heavier than usual. Separation of the sequestrum has occurred at the site of anastomosis between the capillaries of the spinous process and those of the laminae, as shown in Lexer's atlas of the vertebral capillaries. It seems likely that the arterial supply of the third dorsal spinous process may have suffered a pressure anaemia, owing to the patient being recumbent and the spine prominent, and that an embolus of the capillaries may thus have had the best possible chance to extend. I have not been able to find recorded a similar case.

In conclusion, it is probable that the primary illness was a tuberculous adenitis of the groin, since no other primary focus has been found. It would be instructive to know how long it would take for such a sequestrum to be extruded without surgical interference.

THE NO-FOREIGN BODY, TIGHT FITTING WINDOW CAST TECHNIQUE IN OPEN REDUCTION OF FRACTURES*

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The surgeon of old had a real mania to obtain anatomic results and often sacrificed function to that end.

Lucas Championnière showed that good functional results should have been the aim of the surgeon. Over-enthusiasm in his pioneer work carried Lucas Championnière to the other extreme, asserting that anatomic results were not essential to good functional results. Although perhaps no other man stands as prominently as Lucas Championnière in having advanced the methods of treating fractures, his statements should not be taken too literally, especially by the modern surgeon. The improved operative technique, which makes open reduction of fractures a comparatively safe procedure, and the X-rays must stimulate the ambition of the surgeon whose aim must be to obtain *perfect functional and anatomic results. No one can challenge the statement that the functional result in a fractured limb will be better from every point of view when the fragments are put and maintained in such a position that the normal anatomic shape and length of the bone is reconstructed without injury to the surrounding structures.*

We do not advocate the open method in every case of fracture. In fact, in four years the writer has applied the open method in his service at the Greenpoint Hospital in only eighteen cases out of over two hundred fractures, and in practically all cases it has been applied only after the closed or other methods of open reduction had been unsuccessful. We feel, however, that open reduction by the method which we are going to describe should be resorted to more often than is at present the case with the usual open methods.

In this paper we do not intend to review the methods used for open or closed reduction and contention of fractures. We shall present a simple method of open reduction of fractures developed in the last eight years and applied in over one hundred patients, and which has given the most

* Read before the Section of Orthopedic Surgery of the New York Academy of Medicine, March 16, 1924.

satisfactory functional results in clean and infected cases. This method differs from other methods because: the fragments are not held together by foreign bodies of any kind: catgut, kangaroo tendons, wires, plates, screws, bone or ivory inlay and grafts; periosteum or muscles are not sutured; blood vessels, unless very large, are not ligated (on the contrary, free oozing of blood in the wound is not stopped); all loose bone fragments are removed; the fractured fragments are placed in their anatomic position by properly enwedging one fragment into the other and are maintained in their correct anatomic position by a well fitting special window cast. It is the one hundred per cent *no-foreign body method.*

Once understood the technique is simplicity itself, and we say "once understood" because, although this method is the simplest imaginable, surgeons have been trained with such strange ideas about reducing and holding fractured bones together that they are liable to neglect some of the details as not important, thus failing to obtain good results.

We shall not enter into any details regarding general surgical technique. We wish only to remark that all scar tissue has to be removed when the surgeon performs a secondary operation, and that the patient does not need to run the risk of general anaesthesia. In practically all our cases (over one hundred) we used regional anaesthesia for the upper limbs and spinal analgesia for the lower limbs. Contrary to the general opinion, regional and spinal anaesthesias are specially indicated in children, some of whom kept singing and talking during the whole operation, others only complaining of *having lost their legs.*

After the fracture is reduced, the surgeon is faced by the problem of how to keep the fragments in good position. The fragments may lose their proper alignment in two ways:

(1) They slide over each other. (The sliding is due especially to muscular action.)

(2) Lateral motion may displace them or cause angulation. The method to be described solves these problems, *without leaving in the wound any foreign body.*

(1) Sliding of the fragments over each other is prevented by enwedging the fractured fragments into each other so that with the limb left to itself the fracture remains reduced. At times the accident that provoked the fracture provides the best means (X-ray VII-VIII): that is, if there is any notch in the two fragments, with a little skill the surgeon can easily enwedge one end properly into the other. When, however, as is the case in most fractures, the fragments cannot be solidly enwedged one into the other, the surgeon proceeds in the following manner: by the use of any suitable

instrument he makes such notches on one or both ends that one fragment can be enwedged into the other. To do this might require some skill and ingenuity, but with a little practice the surgeon can easily acquire the necessary technique. (Broken wooden sticks provide an excellent cheap material for such practice.) The illustrations show plainly how this enwedging

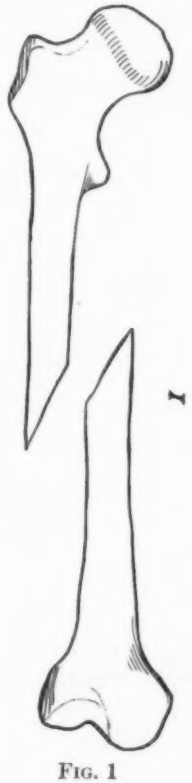

FIG. 1

Schematic view of manner in which fragments of bone are enwedged together.

Typical oblique fracture of femur.

of one fragment into another is accomplished. It is evident that when bones are enwedged into one another in the manner described muscular action cannot dislodge them. On the contrary, the stronger the muscular action the more solidly enwedged the fragments become into one another. It will be seen, and perhaps objected to, that in enwedging the bones in the manner described, we do not obtain an hundred per cent. perfect ana-

tomic alignment, because of necessity we have to enwedge the cortex of one fragment within the cortex of the other and therefore there is a slight displacement of a couple of millimeters. We believe, however, that even the most ideal results obtained with the closed method never attain such

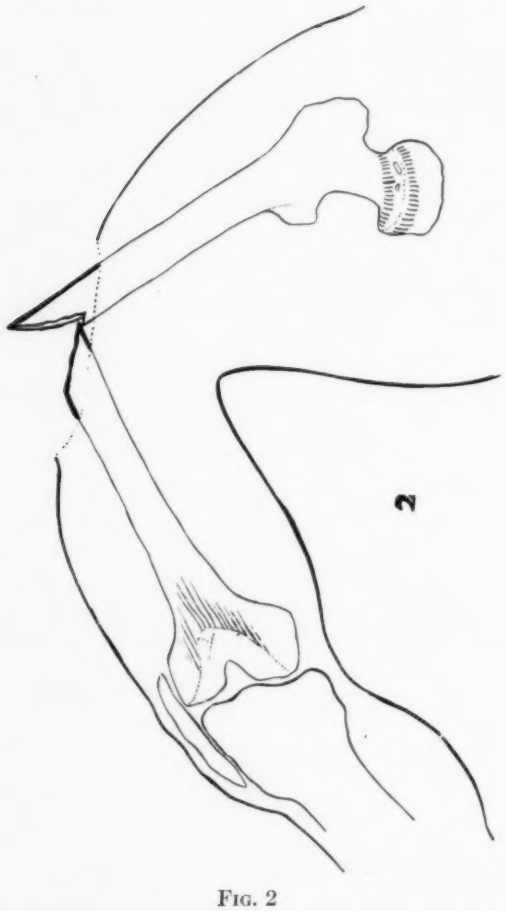

FIG. 2

Exteriorization of fragments and enwedging one fragment into the other.

approximation as the one resulting by enwedging the two fragments, as described, nor better results are obtained when plates, bands, wires, bone inlays and grafts are used.

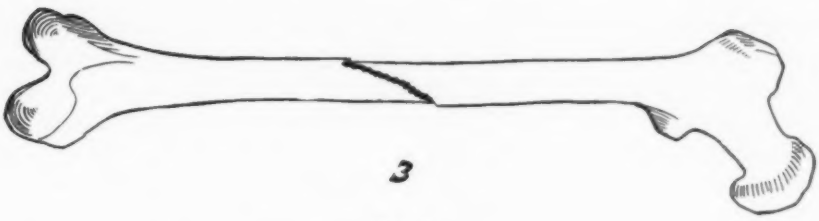

FIG. 3

Appearance of bone when leg is straightened and the two fragments are enwedged one into the other.

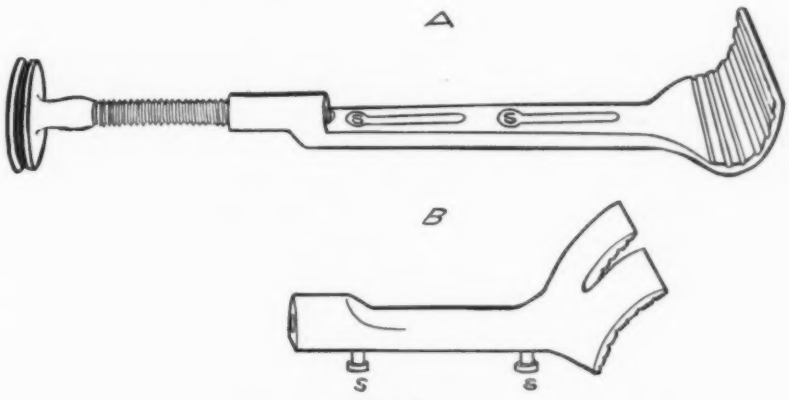

FIG. 4

Bone clamp separated into its two units, A, B. The two units are put together by introducing pins S S into slots S S, turning of the screw closes the clamp. The two units are separated by completely reversing this maneuvre. Note fullness of blade preventing cracking of bone no matter how tightly the clamp is closed. Clamp is made in several sizes in order to meet the size of the different bones.

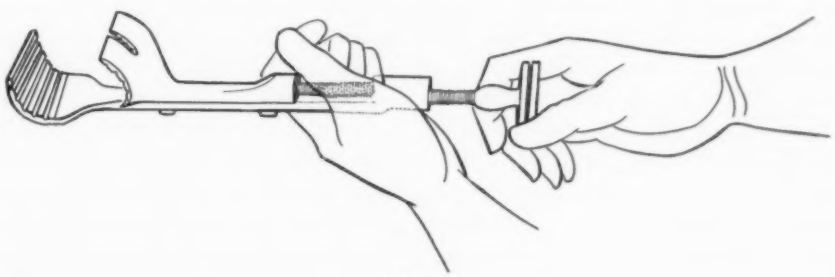

FIG. 5

Showing how the two units of clamp are put and held together and tightened.

(2) Lateral motion must be prevented during and after the application of the cast. In our early cases, in order to prevent lateral motions while the cast was applied, we did depend mostly on the skill and endurance of the assistants. Now we rely on the simple instrument shown in Fig. 4, which is a modified Lambotte clamp. To prevent lateral motion after the cast has hardened, we rely on a well fitting cast (Fig. 15) having a special window, which allows any necessary manipulation. The cast is such an important element that we emphasize the fact that without a perfectly fitting cast the method would fail to give the result that should be expected from it.

The *modus operandi* is the following: The skin is prepared with rubber cement and ether, instead of iodine, in order to prevent irritation, which in some patients might result in blistering. The incision is made according to the location of the fracture and following sound surgical judgment. Once the bone is reached, the limb is bent at an acute angle if the limb has only one bone, or if both bones are fractured at about the same level. Otherwise the ends of the fractured bone are completely exposed by any other suitable manoeuvre. The fractured ends are freed from any anatomic structure, such as muscle, fascia, etc., without, however, sacrificing such structures unless it is absolutely necessary to do so. The fragments are carefully inspected. This inspection might reveal loose fragments of bones and overhanging thickened periosteum, practically detached from the fragment; occlusion of the medullary canal; edges covered with new bone. The fragments must be properly prepared,—that is, the medulla must be rendered patulous, the edges must be refreshened and present a bleeding surface, free from loose fragments of bones and thickened overhanging periosteum. Loose fragments of bone, however huge, must be removed, because if left in the wound they will act as foreign bodies. The fragments are prepared as explained above, making the required notches into them, if such do not exist. The two fragments are then put one against the other in such a manner that the surface of the fragments that are to be enwedged into each other face at an acute angle. (Figs. 1, 2, 3.) The limb is then slowly extended until it has taken its natural position. The special clamp (Figs. 4, 5) is applied at the site of the fracture by introducing first the lower (Fig. 6) and then the upper blade (Fig. 7) and then turning the screw. When the screw is sufficiently turned, so that the two fragments are securely held by the clamp, *the limb should be able to carry its own weight and the fractured ends should not be dislodged by any reasonable amount of motion in any direction.* A sufficient number of stitches, including the skin and fascia, are put in, but not tied (Fig. 8). (If the incision is

very long, one or more stitches may be tied at each end of the wound.) No blood vessels, unless they are very large, are tied: nothing is done to control free oozing of blood. *No foreign body, not even catgut, should be left in the wound around or near the bone.*

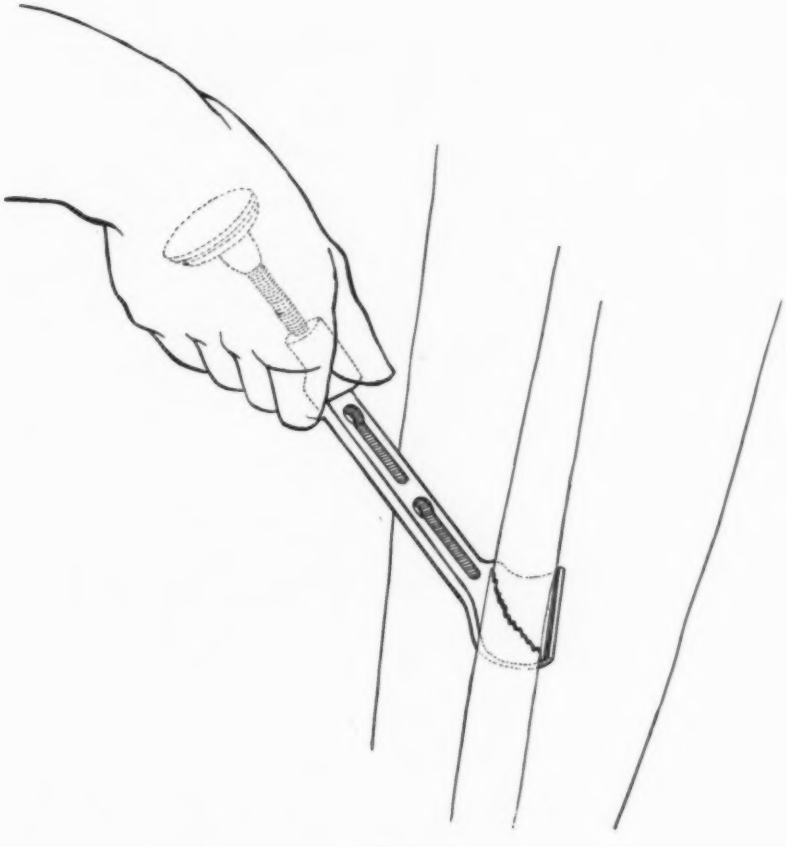

FIG. 6

Showing how posterior blade of clamp is placed behind bone.

The site of operation is covered with sterile gauze, the cast is applied immediately with the limb slowly raised, putting in the window, which will be described below, and making the cast according to the rules also given below. (Fig. 9.) The wound is left open until the cast has hardened,

then the clamp is unscrewed, and by removing the upper blade the condition of the fractured ends can be inspected again (Fig. 10). The clamp is removed; any large blood clots present are cleaned away; the periosteum and the muscles are replaced in their proper position, *without suturing* them;

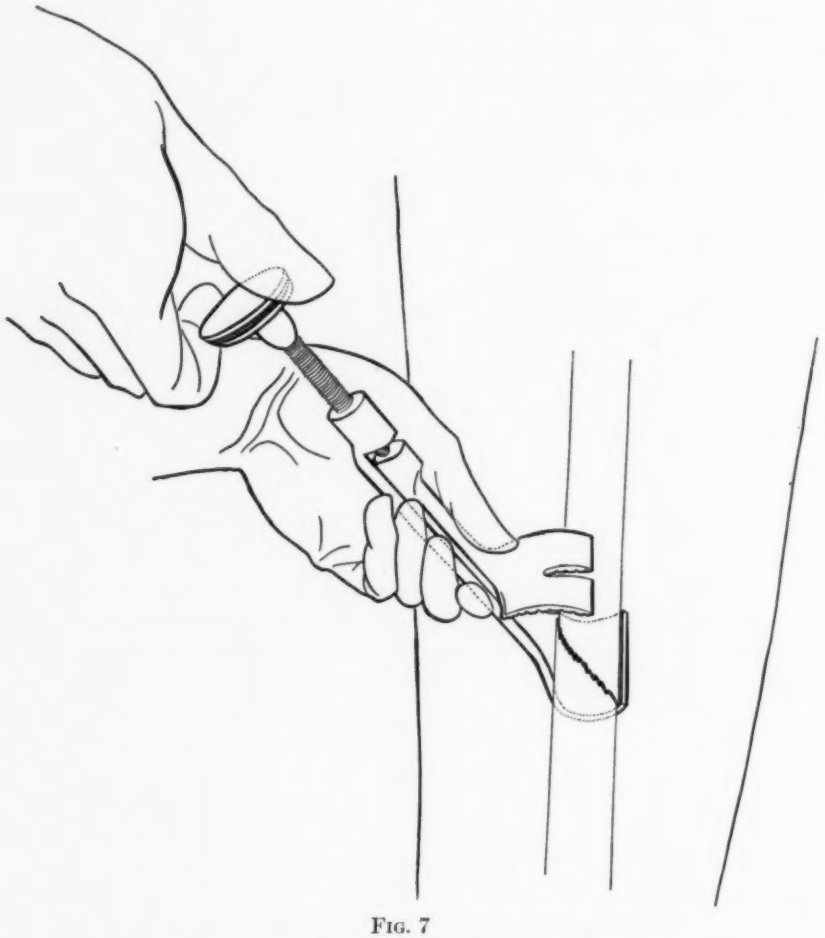

FIG. 7

Showing how upper blade is inserted and tightened around the bone.

the wound is closed; the window box is filled as explained below, and the patient sent to bed. *The limb is immediately elevated at least twenty or thirty centimeters.* If the limb alone cannot be elevated, as in the case of a

fractured femur, the foot of the bed is raised about two feet. The elevation of the limb is a very important step, never to be neglected in any fracture, in order to prevent oedema beyond the cast, which oedema would cause

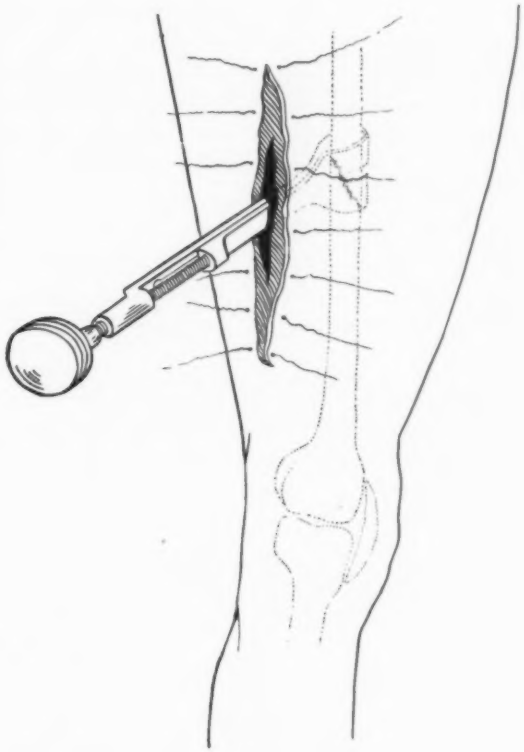

FIG. 8

Schematic view showing how bone clamp holds fragments of bone through wound and how stitches are placed in the wound, but not tied, before applying cast.

severe pain to the patient and require chopping away part or total removal of the cast itself. *If the limb is kept elevated from the very moment that the tight fitting cast (to be described) is applied, no swelling beyond the cast will ever occur—even in infected cases.*

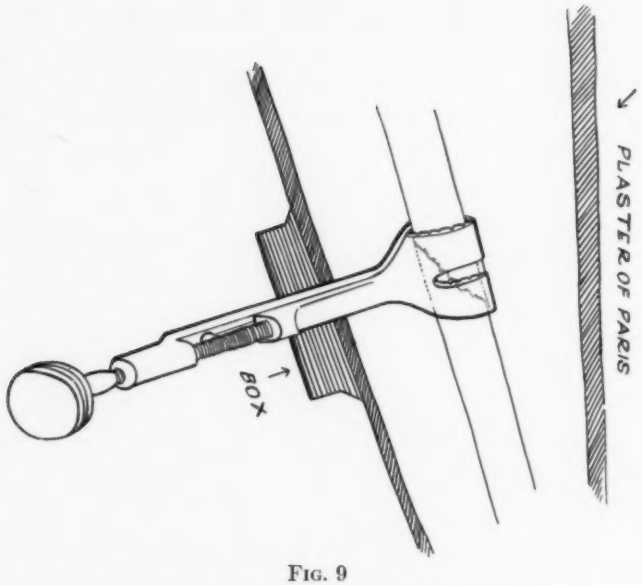

FIG. 9

Schematic view showing clamp holding bone fragments together through cast and box.

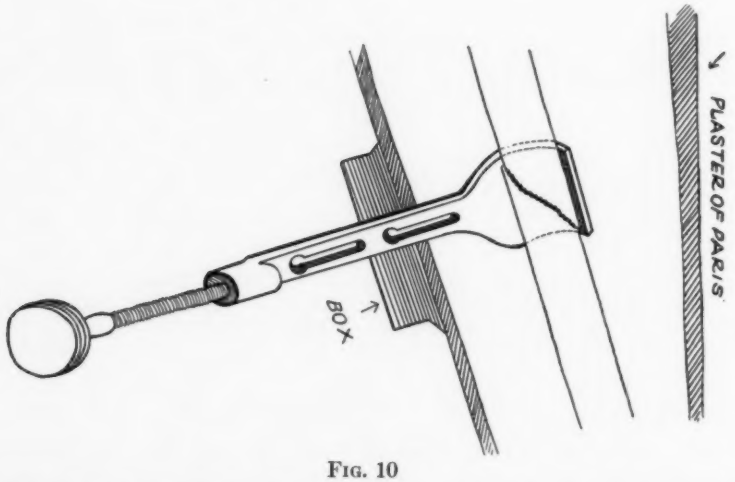

FIG. 10

Schematic view of relations between posterior unit of clamp, bone fragments, limb, cast, and box, prior to its removal after cast has hardened, allowing inspection of fragments.

APPLICATION OF THE CAST

The manner in which some casts are applied cannot be sufficiently condemned. A cast must prevent any motion of the limbs enclosed in it. It is evident that when the limbs are heavily padded with cotton, as is commonly done, motion is not prevented. In order to prevent motion the cast must fit the limb closely, the bony prominences forming obstacles against motion, therefore the limb must not be padded at all: the cast should be like the molding applied by sculptors intending to reproduce limbs. Adherence of the plaster to the skin is prevented by covering it with a light jersey without seams (a woman's stocking will do perfectly). In case neither jersey nor stocking are available the limb is covered with a plain gauze bandage, the bandage being placed smoothly so that no wrinkle results from it. A narrow bandage for this purpose is better than a wide one. *Before applying the jersey, or the bandage, the site of operation is carefully covered with sterile gauze and the jersey cut at the site of operation.*

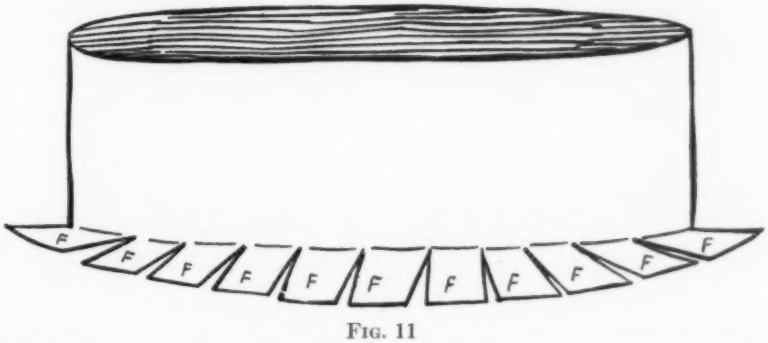

FIG. 11

Showing box with flanges (F) which are to be imbedded in the plaster of Paris.

Plaster of Paris bandages, well soaked in cold water, are applied tightly directly over the jersey or the gauze bandage, and pressed gently, but firmly, at each turn of the bandage, around all bony prominences, such as the malleoli, the patella, etc., *unpadded*. A sufficient space around the site of operation is left open and, after a couple of turns, the special cardboard box (shown in Fig. 11) is applied and the cast is finished in the usual manner. The exterior appearance of a perfect cast must show all the bony prominences as marked as in the normal limb before the cast was applied. The limb is kept elevated while the cast becomes hard, or immediately after when, as in some fractures of the femur, for which the Hawley table

has been used, this cannot be done. The temporary dressing is taken off, the clamp is removed, the sutures are tied. The space left between the box and the limb is then tightly filled with gauze, well impregnated with the

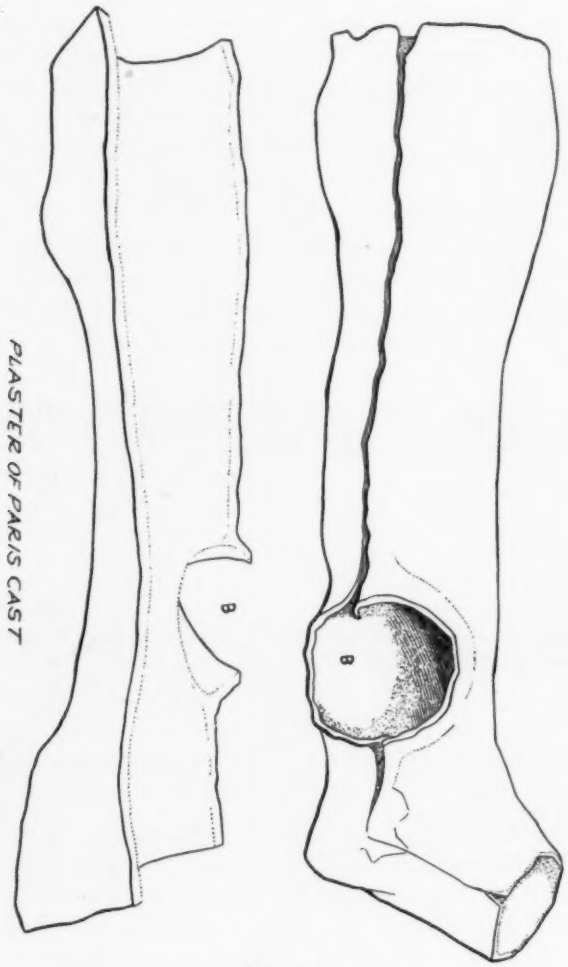

FIG. 12

Showing cast with box (B) and manner of splitting it.

following mixture: Lanoline, 30%; Petrolatum, 65%; Zinc oxide, 5%; obviously sterilized, and the line of incision also covered with gauze. If

this is not at hand, zinc oxide ointment or plain petrolatum will do. The box is then filled in the following manner. Take several layers of gauze of suitable size, dip them in melted paraffine, allow the paraffine to cool off,

Case 1. Boy, 6 years old. Figs. I, II, III.

FIG. I

Shows X-ray picture of leg after closed reduction.

FIG. II

Same view as preceding after open reduction. Several fragments of bones were removed at operation.

but not to stiffen the gauze, line the inside of the box with the still soft paraffinated gauze; the excess of gauze falling all round the outside of the box; fill the box, thus completely lined by paraffinated gauze, with plaster

of Paris, pressing it tightly; cover plaster of Paris with the excess of gauze. The box thus filled with plaster of Paris makes the cast even and strong. If the surgeon wishes to inspect the wound he has only to pull on the paraffinated gauze and the block of plaster filling the box is raised and the wound exposed; the block is then replaced in the box. Through the box any medication can be easily and painlessly applied. However, when the no-foreign

FIG. III

X-ray picture taken forty days after, cast removed, showing huge callus where fragments were removed and perfect anatomic results.

body and tight fitting cast technique is applied, it will surprise the average surgeon how little, if any, medication at all is required in practically all cases.

The special window box is prepared in the following manner:

SPECIAL WINDOW (Fig. 11). A strip of cardboard of sufficient thick-

Case 2. Boy, 7 years old. Figs. IV, V, VI.

FIG. IV

Compound fracture of tibia and fibula.

FIG. V

Same after open reduction. Several fragments of bones not appearing detached in Fig. IV were removed.

FIG. VI

Appearance of leg forty days after operation. (The lateral view, omitted, shows that there is no union between tibia and fibula.)

ness and strength is cut halfway through all its length so that the cut portion, resembling many tails, can be bent at right angle, forming flanges to be incorporated into the plaster. It is then bent on itself so as to form an oval, and secured with a strip of adhesive plaster, clips, or a couple of stitches. It is advisable for obvious reasons to have it sterilized in the autoclave. The box window, besides allowing dressing of the wound, has the advantage of making the cast as strong as if no window existed, because the flanged portion of the box itself is embodied in the plaster surrounding the whole box, so that the point where the box is located is perhaps stronger than any other point of the cast, as when armored cement is used in buildings. Obviously, in case of necessity, more than one box can be applied. The writer, during the war, applied three such boxes in a case of compound fracture of the femur and the tibia with perfectly satisfactory results. In our earlier cases we did not always fill the box with plaster. We found that some cases, especially when a large window was used, presented a slight angulation of the fragments. (Plates III, VI, XVI.) This is completely prevented by filling the box with plaster in all cases.

The Bone Clamps. The clamps shown in Figs. 4 to 10 require only few words of description. The clamp is a modified Lambotte; the jaws are more solid and full around the surface so that pressure on the fragments is evenly distributed, thus preventing breakage of the fragments, which is liable to occur when the original Lambotte is used. The jaws of the clamps can easily be separated or put together; thus the clamps can be easily applied and as easily removed through the box after the cast has hardened, as shown in the illustrations.

THE NO-FOREIGN BODY TECHNIQUE OF OSTEOSYNTHESIS

Before the war the writer had started some experimental work on bone infection, and although the work was interrupted it had advanced far enough to demonstrate that *bones could stand a great deal of infection and trauma, provided no foreign body was present.* The experimental work proved conclusively that there is a great difference in the behavior of bones more or less severely traumatized and infected or either only traumatized or infected, according to the presence or absence of foreign bodies in the bones or closely around them. We do not enter into details, which would carry us too far, but roughly speaking we have noticed that a traumatized and infected, or either simply traumatized or infected bone, if no foreign bodies were present, would stand about three times the amount of infection or trauma, or both, that would harm bones when foreign bodies were present. This experimental work showed, therefore, that the idea that

bones are very susceptible to infection, especially when associated with trauma, is not correct: bones, like the peritoneum, can withstand a great amount of trauma and infection, provided *they are put at complete rest and*

Case 3. Male, 32 years old. Figs. VII, VIII, IX.

FIG. VII

Compound fracture of tibia and fibula.

are absolutely free from foreign bodies. The so-called susceptibility of bones to infection is due to the presence of foreign bodies in or around the bones. It is well to remember that even bone fragments should be considered foreign bodies. The great number of infected compound fractures treated

by the writer in his four years' service in the Army during the late war confirmed completely the experimental results, and the "no-foreign body and tight fitting cast technique" has given the most satisfactory results. The method was described before the Orthopaedic Section of the New York Academy of Medicine and all the patients operated upon in the

FIG. VIII

FIG. IX

Front and lateral view, showing almost perfect anatomic reconstruction. (Three skin clips appear in these pictures.)

writer's service at the Greenpoint Hospital by himself or his associate, Dr. J. S. Baldwin, were presented with their records and X-ray pictures. However, in this paper we present only the X-ray pictures of typical cases, as the presentation of all the X-ray pictures would be impractical. Beside our hospital cases we have applied the method in twenty-six pri-

Case 4. Boy, 12 years old. Figs. X, XI, XII, XIII.

FIG. X

FIG. XI

Supracondylar fracture of femur. Note great deformity and limitation of movements of knee joint.

vate cases, and, as stated before, in a great number of cases during the late war, with the most satisfactory results, even in the cases in which infection was present at the time of the operation. The X-ray pictures are part of the records of these cases, and were made by Dr. Van Winckle, to whom the writer is pleased to tender his heartiest thanks for his invaluable coöperation.

FIG. XII

FIG. XIII

Same, 6 months after. Note complete restoration of bony contours and flexion of knee joint.

Objections to this method that have been raised, when it was discussed before the Orthopaedic Section of the New York Academy of Medicine, were: possibility of ischemic paralysis, on account of the application of the tight fitting cast; necrosis of skin on account of pressure; formation of hematomata; infection due to the fact that the wound is not closed during the application of the cast. The Chairman, Dr. Humphries, answered for the writer concisely and thoroughly by stating that certainly none of the patients presented (two of whom were still wearing the cast) had suffered from such complications. The writer may add that he has never observed such complications.

In order to reduce and treat successfully a fracture that could not be successfully treated by the closed method, and hold it in perfect position, it is absolutely necessary to have good exposure, perfect enwedgment of

Case 5. Male, 64 years old. Figs. XIV, XV, XVI.

FIG. XIV

Compound comminutive fracture of tibia; double fracture of fibula.

the fragments, absolute absence of foreign bodies, and a closely fitting window cast. It will be noticed that we do not sew the periosteum, but only replace it whenever it is possible. We are of the opinion that too much importance has been attached to the periosteum and we think that

suturing this in place has only hypothetical advantages and the positive disadvantage of requiring foreign material to do so. No replacement can obviously be done by the closed method and nevertheless results are perfect in a great number of cases.

FIG. XV

FIG. XVI

Front and lateral view after reduction and removal of all fragments.

The cast is removed as soon as consolidation is secured, the consolidation being ascertained by examining the limb at intervals with the X-rays. Early removal of the cast is advisable. The cast is split in two halves (Fig. 19), which are re-applied after massaging the limb, and the articu-

lations have had proper active and passive movements. Immediate movement of the toes or foot, hand and fingers, after the application of

Case 6. Boy, 13 years old. Figs. XVII, XVIII.

FIG. XVII

Fracture of femur.

FIG. XVIII

Same after reduction. (Skin closed with metal clips, showing in picture.) Note almost perfect anatomic alignment of fragments.

the cast, according to the location of the cast itself, is also to be greatly emphasized. The patient is more comfortable after the proper application of a well fitting cast, than if any other method of contention is applied.

CONCLUSIONS

Open reduction of fractures by the no-foreign bodies and tight fitting window cast technique, represents an advanced step in the treatment of fractures. In the cases in which the method was applied results have

Case 7. Girl, 11 years old. Figs. XIX, XX, XXI, XXII.

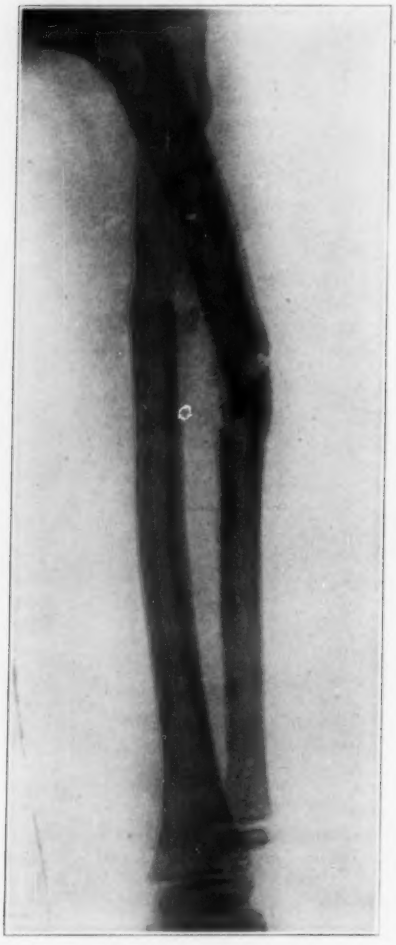

FIG. XIX

FIG. XX

Front and side view of eight weeks old fracture of radius and ulna. Patient attended to in another hospital.

been very satisfactory, none of the complications common to the other methods of open reduction, such as infection, osteomyelitis, necessity of removing the foreign bodies used for osteosynthesis, delayed union, painful limbs, or deaths, were observed. In cases where infection was present

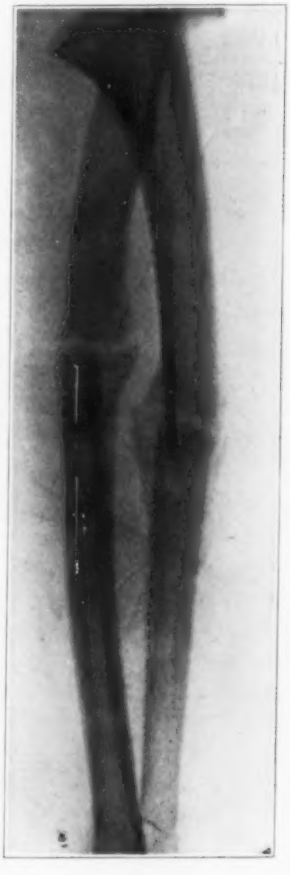

FIG. XXI

FIG. XXII

Same five weeks after open reduction.

no unpleasant complication was noted; the results were as satisfactory as in the clean cases. This fact demonstrates that complications noted when other methods are followed *are due to the presence of the foreign bodies used in the process of osteosynthesis.* It follows that foreign bodies prevent

the proper formation of callus and favor infection, while direct good coaptation of the fractured ends of the bone, presence of blood, complete absence of foreign bodies in the wound, mean better union, because callus formation is not hindered; better function, by preventing infection, dam-

Case 8. Female, 59 years old. Figs. XXIII, XXIV, XXV, XXVI.

FIG. XXIII

FIG. XXIV

Front and side view of old Colles' fracture of fourteen weeks duration. Attended to in two other hospitals.

age to nerves, blood vessels, muscles and tendons. Contrary to the generally accepted opinion, bones can stand a great deal of trauma and infection, the ordinary usual complications following trauma and infection *being due to the presence of foreign bodies*, which are injurious to the process of bone repair.

POINTS TO BE EMPHASIZED

Fractured bone should be reduced and maintained in proper position without leaving any foreign body in the wound. A cast that is applied

FIG. XXV

FIG. XXVI

Same after open reduction. Later functional result excellent.

without padding the limb is indispensable to maintain the proper coaptation of the fractured bones. The elimination of foreign bodies and the application of the tight fitting cast allow the greatest comfort to the patient.

NEW METHODS FOR STUDY OF DISEASES OF THE CIRCULATION OF THE EXTREMITIES*

BY BARNEY BROOKS, M.D., ST. LOUIS

A paper presented before this society a year ago emphasized the following points:

The greatest need in the treatment of the disabilities of the extremities due to the diseases of the vascular system is methods of examination. Methods of determination of the volume flow of blood which are in use by the physiologists are not applicable in clinical medicine. Methods of determination of blood pressure are sufficiently accurate only for estimating blood pressures relatively high and only in vessels which have a considerable pulse pressure. There is no method for determining the site and extent of obstruction of arteries.

The object of this paper is to report subsequent investigations of methods of determining the degree of deficiency of the circulation in tissues and the site and extent of arterial obstruction.

The first method to be described is a modification of the well-known Moszkowicz test. In the Moszkowicz test the criterion of the degree of circulation disturbance is the change in color of the skin which results from the alternate application and removal of a tourniquet. In the test to be described the criterion of the efficiency of the circulation of tissues is change in temperature as a result of the application and removal of a tourniquet. The apparatus used consists of a thermocouple mounted in a hypodermic needle and a galvanometer. This apparatus permits the accurate measurement of the temperature of tissues and records accurately rapid changes of this temperature. The needle is inserted into the tissue the circulation of which is to be determined, and a tourniquet is applied in such manner as to stop completely any blood flowing through the tissue. It is obvious that the temperature of the tissue will then fall. When the circulation has been completely stopped for a period of ten minutes there is an appreciable fall in temperature. The tourniquet is then removed and the changes in the temperature of the tissue are carefully studied. It has been found that in the tissues of the normal ex-

* Presented at the Annual Meeting of the American Orthopedic Association, May, 1924.

tremity the removal of the tourniquet is followed by an immediate and rapid rise of temperature to its former level. In the tissue of an extremity in which there is impairment of the arterial blood supply the release of the tourniquet is not followed by an immediate and rapid rise of temperature. In any disease in which there is obstruction of the large arteries there is an appreciable period of from one to ten minutes elapsing between the removal of the tourniquet and the beginning of the rise in temperature of the tissues to be tested. In conditions of marked arterial obstruction the application and removal of a tourniquet may cause no temperature changes in the distal tissues. By the application of this method to the tissues of various levels and distributions of main arteries it is possible to obtain valuable knowledge as to the condition of the arterial circulation of the extremity.

If the application of the method just described demonstrates the presence of arterial obstruction, the exact site and extent of this arterial obstruction can be determined by injection of sodium iodid into the arteries and by roentgenologic examination. This method has already been described (Journal American Medical Association, Vol. 82, p. 1016). Briefly the method consists in exposing the primary artery of the extremity to be examined, applying a clamp to the artery and injecting a concentrated solution of sodium iodid into the artery distal from the clamp. A roentgenogram is made immediately after the injection. The detailed technique may be found in the original article.

The application of these two methods of examination has made it possible to obtain exact information as to the extent of arterial obstruction existing. This knowledge has made it possible to proceed with the treatment of diseases of the circulation of the extremities with a feeling of confidence which we have not heretofore felt. I hope that at the next meeting of this society we shall be able to report progress in the treatment of these conditions which have heretofore been considered irremediable.

DISCUSSION

Dr. J. W. Sever, Boston, Mass.: I think Dr. Brooks has given us a very valuable and useful method of determining the condition of the arterial circulation in these cases. You know when the case comes to you the question has been not so much of palliative treatment, but one of operation and if we do any operation it is of necessity going to be an amputation above the knee-joint because those of you who have operated below the knee-joint know that you have always had to operate again above the knee, provided the arteries were sufficiently occluded. There must have been, as Dr. Brooks's study has shown, a certain percentage of cases which have been unnecessarily amputated. If we can avoid that small percentage by carrying out his method of injection first of

all, or by his thermal tests of determining the temperature reaction of the tissues or determining that the circulation is satisfactory, and then by injection of sodium iodid and X-ray taken immediately showing that the arteries are open, a large percentage, or at least a certain percentage, of cases will not only avoid unnecessary operations, but will at least avoid mutilating operations or unnecessary amputation. It seems to me this is a very great step forward, and in this study of twenty-five or thirty cases so far as he has shown where he has injected sodium iodid he has had no untoward results. He has been able to show very definitely with the X-ray following such injection the absolute position of the arteries and their pathologic condition. That makes a very good use of the X-ray after all. It is a simple diagnostic test which is now available and which we should use to eliminate the guess-work to which we are so prone to resort.

Dr. Barney Brooks, St. Louis, Mo. (closing the discussion): There is just one point I would like to make. The injection of these vessels and the resulting X-ray picture has given the most striking results which we have obtained. However, the other test is absolutely harmless, and I am convinced that the more it is used and the more the method is studied the less often it will be necessary to resort to injection of the arteries. The arteries which I have injected have been in a great many cases almost completely occluded, as the lantern slides have shown. It would seem that if there were to be bad results from these injections we would be most apt to get them in the cases in which the arterial obstruction was great and in which there was already existing an arteritis. We have seen no manifestations of harm, and yet I do not believe that the method is a safe one to be indiscriminately used.

OSTEOCHONDRITIS DISSECANS

BY MAURICE A. BERNSTEIN, M.D., CHICAGO

The occurrence of cartilaginous or osteocartilaginous loose bodies in joints is a fairly common clinical finding, and as a result an extensive literature has sprung up on this subject. The only excuse for offering a further contribution to this literature is that the subject is still of great interest, owing to the uncertainty of the origin of these bodies in joints and especially because of its more common occurrence in the knee-joint. Moreover, in the cases which I am about to report some circumstances were observed which might help to elucidate the pathogenesis. The circumstances are the occurrence of loose bodies in three members of the same family and in all three cases both homologous joints were affected, loose bodies being either actually present or else a condition being present which presumed their existence.

The loose bodies to which I refer are those arising from the femoral articulation and designated as osteochondritis dissecans, differing from a more common condition of loose bodies which arise either from the tissues within the joint itself or in its immediate vicinity. Although the term "foreign body" has at times been applied to the former group, this name is not strictly applicable to the free or pedunculated cartilaginous or osseocartilaginous bodies which are often found within the joint. Such loose bodies occur in all the different joints or simultaneously in homologous or different joints; they are, however, more commonly found in the knee-joint, arising from the inner surface of the mesial femoral condyle, and referred to as "osteochondritis dissecans." It is with such that I wish to deal in this paper.

Osteochondritis dissecans may be considered a constitutional disease involving the articular surface of long bones, more frequently the mesial condyle of one or both femora, but may involve the elbow and shoulder joints, etc. The disease is probably hereditary, affecting more than one member of a family, as will be shown in this report. It first manifests itself as an elliptical or almond-shaped rarefication of the peripheral border of the mesial condyle, which after a time becomes free at the outer peripheral border, finally loosening up and becoming attached by a fibrous band to the condyle, or actually freeing itself and becoming a loose body within

the joint. When the disease is first discovered the articular surface of the joint, aside from this defect, may appear normal in contour; later, however, the articulation becomes enlarged, irregular in outline, and shows osteophytic outgrowths. The joint space is decreased, and in the knee-joint the tibial spine is elongated, deformed, and approximating the intercondylar notch. The synovial membrane may at first be unchanged, but later participates in the irritative, chronic infiltrative change, becoming elongated and presenting villous fringes with cartilaginous bodies attached. Other cartilaginous bodies may be present, but these are secondary to the primary single body originally separated.

Osteochondritis dissecans must be classed as a definite clinical entity differing from the other condition often confused with it, namely, osteochondromatosis, a disease involving the large joints, the knee and elbow especially, with the development of multiple loose bodies within the joint, and perhaps originating from the synovial membrane. The clinical picture of the two diseases is so closely associated that it becomes necessary to differentiate the two. This can best be accomplished by several illustrative cases.

Case 1. I. S., male; age 37 years.

Past History: Has no bearing upon present condition. He states that he has had pain and discomfort in both knees for about fifteen years. His knees were always larger than those of other boys. The knees never became swollen or red, nor did they ever lock at any period prior to 1918. In February, 1918, the patient tripped and fell against a table, striking his right knee; the knee became swollen, painful, and locked in the flexed position. When the acute symptoms subsided he could flex the knee, but could not fully extend it. He had considerable discomfort when walking, and was operated on several days after his accident for a torn internal cartilage. Loose bodies were discovered in the opposite knee and were removed at the same time. The patient remained free from pain for three months, when sharp, shooting pains recurred in his left knee. There was no locking at this time. The injured knee was uncomfortable for two years, pain and locking recurring about every three months. The locking has recently become more frequent and it is for this that he now seeks relief. (Fig. 1.)

Operation. Right knee. Split patellar incision was employed. The synovial membrane appeared thickened, elongated, and presented numerous villous off-shoots to which were attached cartilaginous bodies. Numerous free bodies were found within the joint. The articular surface of the femur appeared rough in places, but no evidence of erosion was evident.

FIG. 1

(CASE 1.) Anteroposterior and lateral view of the right knee-joint before operation. Numerous loose bodies are seen in the lateral view. The one in the suprapatellar space was felt through the skin. The one between the articulation was responsible for the locking of the joint and the acute symptoms which were present. In the lateral view it can be seen that the loose body corresponds to the defect which is present in the femoral condyle. There were a number of bodies deposited in the posterior compartment of the knee-joint. These were left undisturbed. The defect in the femoral condyle is quite characteristic of osteochondritis dissecans, showing no break in the continuity of the periphery, but a distinct rarefaction, as if the defect was filled in by bony tissue. The anteroposterior view shows a marked denudation of the mesial condyle, with a tendency to bone regeneration, as indicated by the dense bony outgrowth at the intercondylar space. The joint surface is markedly decreased and there is evidence of impingement of the tibial spine upon the intercondylar notch, a point to which Freiberg called particular attention.

Left knee: Incision as in the right. On examination, similar changes were observed in the synovial membrane of this joint as in the other. Six loose bodies were recovered. The mesial condyle of the femur showed a slight defect, to which was attached a good sized cartilaginous body. This was apparently precipitated into the cavity of the joint at the time when the loosened cartilage was removed, and in time would in all probability have become spontaneously detached.

FIG. 2

(CASE 1.) One year after operation, showing the absence of the loose bodies with the persistence of the defect in the mesial condyle. Notice that the density of the defect is considerably increased and that the bony offshoot, which was shown in Fig. 1, has assumed a more rounded appearance. Note the changes in the left knee-joint. This presents practically the same picture as the right.

CASE 2. Female, age 21 years (sister of Case 1). Past history shows some throat trouble; otherwise has been well. About two years ago, after jumping two steps, sprained her knee. Effusion soon followed and she could not extend her knee as before. Soon after this injury she began having trouble with the opposite knee. The knee is unstable, gives way after a long walk and becomes swollen. (Fig. 4.) This case was reported by Dr. John Ridlon as a case of osteochondritis dissecans.

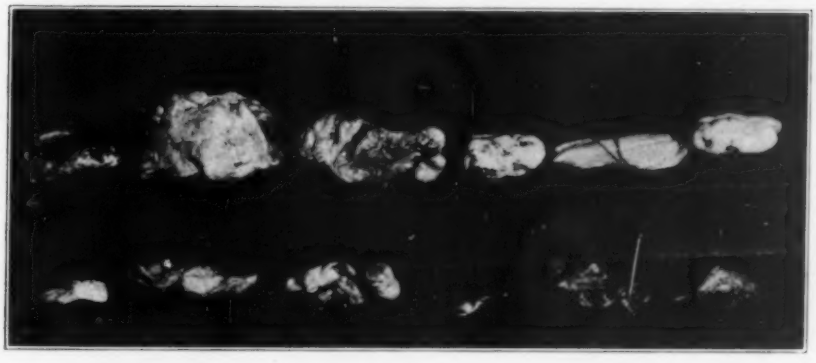

FIG. 3

Photograph of loose bodies removed in CASE 1. There were nine large sized bodies in all. The specimen in the right lower corner of the photograph shows the fringes of synovial membrane which presented into the joint. To these were attached osteocartilaginous bodies. This finding led us to believe that we were dealing with an osteochondromatosis rather than with osteochondritis dissecans, and it was only through the study of CASE 2 and CASE 3 that the diagnosis was made.

CASE 3. M. S., female, age 40 years (second sister of Case 1). Up to the present has been free from trouble in her knees. As far back as she can remember her knees were larger than those of other girls, but she could run, jump, and bend her knees as well as her playmates. Of late, however, the knees have felt stiff on occasions and the patient states that she can feel a cracking sensation in both knees when bending. If it were not that her brother and sister had knee trouble she would have paid no attention to herself. On examination, the knees are found irregular in shape and broader in outline than normal. There is a definite crepitation on motion, limitation to full extension, but no lateral mobility when the knee is in full extension. Rough areas can be felt as if there were exostoses. (Fig. 5.)

COMMENTS

A search of the literature failed to disclose a report of osteochondritis dissecans occurring in more than one member of the family. This circumstance, together with its presence in both knees of these individuals, would tend to dispose of any theory of trauma as a causative factor. A twist with forcible flexion of the knee may hasten the separation of such a body by a pull upon the posterior crucial ligament, if this mechanism is at all a contributory factor, as Barth maintains. Case 1 has had trouble with his knees as long as he can remember and states that his knees were

always large. The injury which he sustained to the left knee intensified the preëxisting condition and probably hastened separation of the attached body. When the knee-joint was opened by the transpatellar route the most striking disorder observed was an elongation of the synovial membrane and villous outgrowths with cartilaginous bodies attached. These were not visible in the roentgenogram. (Fig. 1.) The surface of the femoral

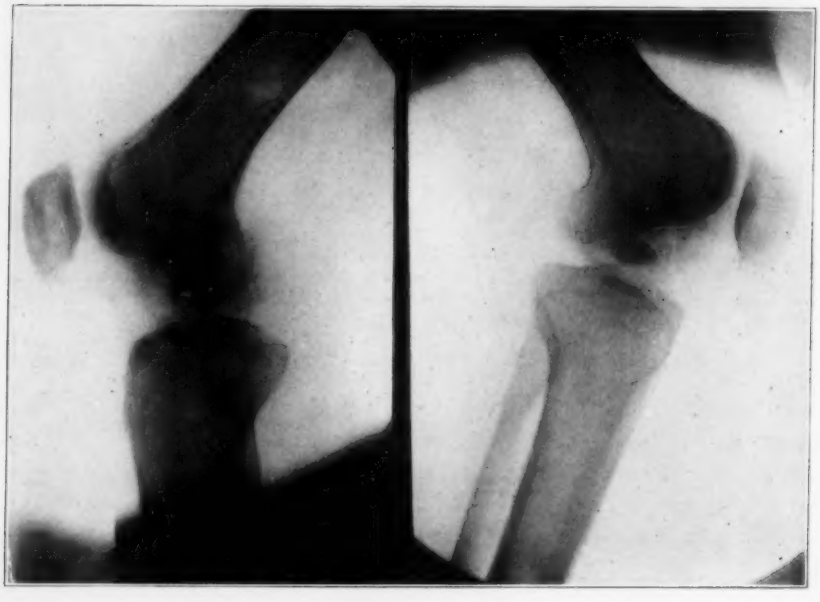

FIG. 4

(CASE 2). Right and left lateral views of the femur. Note the defect present in both femoral condyles, with the bodies detached but lying opposite the corresponding defect. Upon careful examination it can be seen that there are other loose bodies present. Both knee-joints were operated upon and the loose bodies removed.

articulation did not seem much changed, perhaps appearing somewhat congested and slightly roughened. The inner surface of the mesial condyle did not present a sharply defined defect which showed in the roentgenogram prior to the operation. It gave the impression that if a defect did exist, it became filled in with bony tissue. In addition to the large cartilaginous body, which presumably caused the locking of the joint, there were other smaller cartilaginous bodies which were not suspected, filling the recesses

of the knee-joint. Only those bodies occupying the anterior compartment of the knee-joint were removed, although it was known that cartilaginous

FIG. 5

(CASE 3.) Anteroposterior view of the knee-joint. Although loose bodies are not visible in this roentgenogram, a distinct separation of an almond-shaped body at the mesial femoral condyle is discernible. This body is apparently separated at the periphery, but it is firmly attached at superior border of the intercondylar notch. The joint space is markedly decreased and the tibial spine elongated and approximated to the intercondylar notch. Other changes are visible in the knee-joint, as lipping at the periphery and the widening of the tibial and femoral articulation.

This roentgenogram is typical of osteochondritis dissecans described by Freiberg and others.

bodies occupied the posterior compartment as well. Because of the number of bodies found and the character of the synovial membrane, together with the gross appearance of the articular surface of the femoral condyle,

a diagnosis of osteochondromatosis was made. After studying the roentgenograms more carefully and comparing them with those of Cases 2 and 3, it was decided that the condition was really osteochondritis dissecans.

Freiberg[1] states that the invariable situation on the internal condyle of the femur, the separation leaving a small niche in the condyle always of the same general shape, points to some peculiarity of the local circulation as the fundamental factor in the production of this derangement. He states that the process seems almost invariably akin to that of infarction. In one of his cases one year after operation the niche in the bone, although smoothed off at the edges, could be easily seen. It is of interest to note that he was the first to describe this condition in this country. In speculating on the pathogenesis of this condition, he quotes Ludloff, who says that in his opinion in simultaneous hyperextension and inward rotation of the joint, the arteria genu media, a terminal vessel which ramifies over the posterior crucial ligament and the internal condyle of the femur, may be injured, causing a circumscribed necrotic area corresponding to the defect in the mesial condyle. Freiberg was unable experimentally to reproduce this defect.

HISTORICAL NOTES

Halstead[2] states that the first systematic study of foreign bodies in joints was made by Pechlin, a Swede, about two hundred and fifty years ago. In 1726 Munro[3] advanced the theory that the occurrence of such bodies was due to traumatism. Laennec's theory, advanced in 1854, virtually displaced Munro's. Laennec[4] thought that loose bodies in joints were primarily extra-articular; that they formed in the subsynovial cellular tissue and pushed into the joint cavity; that they were pediculated, but could, and often did, become free. Laennec's theory seemed to be that, consecutive to an arthritis, cartilage could develop in the thickness of the fibrous capsule or in the synovial tissue, and was at first articular.

In 1851 Rokitansky[5] considered that osteocartilage could arise from the articular serosa, the pathogenic factor being excessive development and ulterior ossifications of isolated cartilage nodules which are often found to exist in the serosa.

John Hunter[6] considered that loose bodies in the knee-joint were organized blood clots that became attached to the articular cartilage and assumed its character. Hunter maintained that blood when effused tended to organize and adapted itself to the tissues in which it was effused.

Rainey[7] advanced a somewhat similar view to Hunter's, holding that detached fragments of tissue continued to grow in their new situation inde-

pendently of their parent structure. Many observers are of the opinion that the synovial fluid nourishes the detached cartilage. Rainey was the first to describe detachment of the villous process in synovial membrane.

In 1889 Tourneux[8] and Hermann showed that loose bodies could arise from the synovial membrane itself, this and the articular membrane having the same embryologic origin, with the possibility of synovial cells returning to the original condition of cartilage. Lexer[9] upheld the view that loose bodies might arise from embryonic "rests" of cartilage.

Poulet and Vaillard[10] considered that loose bodies in joints could be classed under four types:

1. Loose bodies of traumatic origin.
2. Loose bodies derived from peri-arthrodial osteophytes.
3. Loose bodies developed in the thickness and at the expense of the diarthrodial cartilage.
4. Loose bodies produced by sequestrations of the fragment of the articular heads.

These authors seem to favor the view that loose bodies in joints were always an expression of some stage of dry arthritis. They considered that the condition could be symmetrical in homologous joints and that pathologic loose bodies, as distinguished from the traumatic loose bodies, could appear spontaneously in a more or less diseased joint as a secondary manifestation, contingent on the pre-existing articular affection.

Following Poulet and Vaillard, Koenig,[11] in 1887, described what he considered as a distinct morbid entity, an inflammatory affection of unknown origin which he termed osteochondritis dissecans. This condition was supposed to result from occlusion of small end-arteries supplying an area on the mesial surface of the internal condyle of the femur and resulting in the separation of a small portion of the condyle which fell into the joint cavity. Koenig admitted that osteochondritis dissecans could also result from trauma. Koenig's views met with much opposition, even in Germany, Barth, Schmieden, and others writing strongly against them.

Henderson and Jones,[12] basing their view on a study of literature and on their own clinical investigations, consider that there are three definite conditions causing formation of loose bodies in joints:

1. Osteochondritis dissecans.
2. Hypertrophic arthritis.
3. Osteochondromatosis.

In the first, these authors say that there are rarely more than one or two bodies which arise from the internal condyle of the femur. As admitted by Koenig, the condition could be present in homologous joints.

In hypertrophic arthritis the loose bodies may be produced by osteophytic growths breaking off and falling into the joint, this condition being more usually observed in elderly persons and associated with osteoarthritis.

In osteochondromatosis, according to Henderson,[13] the thickened synovial membrane takes on the property of forming osteocartilaginous bodies. The characteristic of this condition is the large number of foreign bodies, and in some cases hundreds of loose bodies have been removed from one joint. Henderson thinks that a possible explanation may be that the synovial membrane and cartilage and bone of the joint have a similar embryologic development; that cells may become displaced which later produce cartilage and bone. Loose bodies may be considered as a kind of benign tumor. This is an expansion of the view already put forward by Tourneux and Hermann.

The various pathogenetic theories just referred to may be reduced to traumatism, tumors arising from embryonal "rests," and mechanical invasion of the joint by extra-articular loose bodies, which includes Laennec's and Koenig's views and Lexer's infarction theory. It seems, however, that no one theory covers all cases met clinically. Traumatism of the knee-joint is so frequent that if it alone were the cause of loose bodies, these should be found with a far greater frequency than is actually the case.

The theory of extra-articular loose bodies pushing into the joint scarcely agrees with the definitions of loose bodies arising within the joint itself. It would appear to me that there must be some underlying constitutional factor, probably a congenital predisposition of the joint tissues, which is indispensable in the formation of loose bodies in joints. Such a view would account for the facts observed in the special cases which I report, where three members of the same family showed loose bodies in the knee-joint. It would also account for the occurrence of loose bodies in homologous joints in the same patient. Granting the existence of such an hereditary predisposition, any exciting cause, such as traumatism, inflammatory changes would act as an exciting cause for the formation of loose bodies in such a joint. The similar embryonic origin of the articular cartilage and synovial membrane, with the possibility of cells from the latter returning to the state of cartilage, as pointed out by Tourneux and Hermann, and the view held by Lexer and others that loose bodies could arise from embryonic "rests" are only particular cases of predisposed joints.

It is probable that such a familial predisposition of the knee-joint exists rather frequently. Cases of loose bodies have been known to exist for long periods without producing obvious symptoms, and unless they cause much pain or marked inability of the joint movements, they are apt to be

overlooked, many cases of loose bodies having been discovered only accidentally or at autopsy.

In regard to bilateral occurrence in such cases it is rather singular that all three familial cases were bilaterally affected. The fact that bilateral loose bodies may occur in homologous joints has been admitted by Poulet and Vaillard, Koenig, and others, and cases of the kind have been reported by Clutton,[14] Clarke,[16] Arbuthnot Lane,[17] Koenig,[18] Hammesfahr,[19] Morton,[20] LeConte,[21] Championnière,[22] Weichselbaum,[23] Henderson,[24] Carothers,[25] and others. In many of these, such as the cases of Clutton, Bowlby,[15] Championnière and Weichselbaum, as might be expected, there was no history of traumatism or else of some trauma to one knee only.

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CONGENITAL DISLOCATION OF THE HIP IN YOUNG ADULTS*

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It is a well known fact that the difficulties which are encountered in attempting to reduce congenitally dislocated hips rapidly increase as the child advances in age with the hip unreduced, and that this is especially true in bilateral cases. In the report made in 1917 by Elliot Dixon and myself,[1] we described our experience with ten patients having twelve hips that had been subjected to open reduction. One of these patients had reached the age of 25 years with the dislocation unreduced, and in her case a marked improvement was accomplished by securing an anterior transposition of the dislocation. In four patients with single dislocation, there was a satisfactory reduction and a good return of function. In one patient with single dislocation, reduction was obtained, but the wound was infected and the hip became stiff. In two patients with single dislocation, the sciatic nerve was injured, in one of which recovery took place, and the other only partially recovered.

It seems that the main difficulty in reducing hips in older children and young adults who have congenital dislocations is the resistance of the capsule and the anterior structures about the hip. In a study of the anatomy of a congenital dislocation of the hip made on a specimen taken from a child who died of pneumonia several months after reduction, the following observations were made.

The obstacles to be overcome in these cases may be summarized as follows:

An acetabular cavity not of normal development.

A femoral head that is more or less irregular in shape.

A changed direction in the neck of the femur.

An adductor group of muscles too short before operation, and after operation injured both as to muscular elements and nerve supply.

All the posterior muscles with the fascia lata and the ilio-tibial band much shortened.

An ilio-femoral band abnormally short and strong.

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On this last element I wish to place especial emphasis. It is obviously true that unless these structures, especially the capsule and the ilio-psoas tendon are in some way divided, it is impossible to bring the head of the femur down and replace it in the acetabulum. Operative procedure designed to do this at one operation exposes the patient to a considerable degree of violence with a possibility of injury to the circulation in the extremity and to the nerve supply of the thigh and leg.

FIG. 1. A

Girl 18 years of age. Single congenital dislocation.
A. Hip before operation.

Dr. Frank D. Dickson[2] presented a paper before the American Orthopedic Association in 1923 in which he advocated the operative procedure which would make no attempt to reduce the dislocation, but would supply stability to the dislocated hip by providing a shelf turned down from the ilium which would act as a bony block to its excursion on the dorsum. Dickson reported several cases which benefited by this procedure.

In the past year I have attempted reduction on two cases, one a girl of 18 with a single dislocation, and the second a young man of 18 with a single dislocation. In these two instances I have departed from the former method of attempting reduction of the hip at one operation, and have resorted to the foliowing procedure: The hip has been exposed by the Smith-Petersen procedure; the anterior capsule has been divided and the ilio-

FIG. 1. B

B. Hip during period of skeletal traction with head approaching the margin of the acetabulum.

psoas removed by section of the lesser trochanter, and the head of the femur brought forward from its position on the dorsum of the ilium to a position directly above the acetabulum. The wound has then been closed and caliper skeletal traction applied to the lower end of the femur. The patient has been returned to bed, the leg supported in a Thomas splint with the knee flexed and an amount of traction has been applied to the ice tongs which has varied with the patient's power of endurance. The amount of direct

skeletal traction constantly applied has been never below 25 pounds and ranged from this to 40 pounds. The journey of the head downward toward the margin of the acetabulum has been checked by roentgenograms taken at intervals of one week after the operation. At the end of the third week, in each instance, it was found that the head was resting just superior to the upper margin of the acetabulum. In each instance, at this time, a second operation was done through the former incision, removing the scar and

FIG. 1. C

C. Reposition of head after second operation.

exposing the hip after the method of Smith-Petersen. In each instance it was found that the acetabulum was completely filled with dense fibrous tissue which was difficult to remove, but which was removed entirely, exposing an acetabulum of good capacity with apparently normal cartilage covering its surface. In the case of the single dislocation in the girl of 18 there was practically no distortion of the angle which the shaft made with the neck of the femur, and here it was possible to replace the head of the

femur in the acetabulum without difficulty. The wound was closed, the limb being held in 45° of abduction and without distortion. In the other patient it was found that the head could be replaced without difficulty in the acetabulum, but that so placed the lower extremity was thrown into a position of 90° internal rotation, this being accounted for by the twist in the upper end of the femur. In the man of 18, an osteotomy was done to overcome this 90° of internal rotation three months after reduction of the hip.

FIG. 2. A

Young man, 18 years of age. Single congenital dislocation.

A. Hip before operation.

It seems to me from this experience that it is possible in certain cases to correct extreme and painful and disabling deformity of the hip by open reduction. It would seem that the operations necessary for the accomplishment of this correction are both severe and dangerous, and that during their prosecution as little force as possible should be used to secure a reduction.

After young adult life, the procedure of Dickson is advisable to the operations here described, and this would hold true also in the individuals who are not in a robust condition of health. The difficulties and dangers which are encountered in making these attempts at restoration of function in old dislocations of the femur indicate the necessity for reducing these dislocations of the hip during the early years of childhood.

FIG. 2. B

B. Progress of head toward acetabulum after the hip was freed at operation. Heavy skeletal traction being applied to the lower end of the femur.

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DISCUSSION.

DR. A. BRUCE GILL, Philadelphia, Pa.: Some years ago there began coming to my clinics patients from fourteen to twenty-three years of age who had congenital dislocation of the hip. They came to me because their hips were painful and because in some in-

stances they were so disabled that they were practically confined to the house. Some of these cases had had reduction made in childhood and some had not. Those that had been reduced did not stay reduced. My interest was thus aroused in open operation for dislocation of the hip, as I felt that something must be done if possible for these patients to free them of pain and to reduce or remove their disability. Beginning on these older patients, I have come in more recent years to operate also on certain of the younger cases, as early as three to five years of age.

FIG. 2. C

C. Reduction of hip after second operation. In this case it was necessary to do an intertrochanteric osteotomy to correct the extreme internal rotation of the femur.

My present position in regard to reduction of congenital dislocation of the hip is that we should attempt bloodless reduction in children as old as eight to ten years of age, with the understanding that of course the older the child, the less likely are we to secure efficient reduction or to maintain it. We should employ the means of reduction that we are individually familiar with because there are a number of good ways of reducing the hip and various orthopædic surgeons obtain good results by their own methods in a certain percentage of cases, varying from fifty to sixty or seventy per cent. In this per-

centage of cases we all get a good result from our own method of reduction, with which we are familiar and with our methods of after-treatment.

I doubt whether it is wise to lay too much stress upon the method which is employed in these cases or to recommend any complicated procedure for after-care, because I think that our good results are not so much dependent upon the method of reduction or the form of after-care as they are upon the anatomic structure of the hip joint with which we are confronted in these cases. If we confine ourselves entirely to bloodless methods of treating congenital dislocation of the hip we are all confronted with a certain percentage of cases of failure no matter what method of reduction, no matter what method of after-treatment is employed. These are the cases in which the anatomic structure of the dislocated hip departs so far from the normal that either the hip cannot be reduced or it will not stay reduced over a period of years, no matter what method of bloodless treatment is employed.

I have never yet opened a hip joint in either old or young in which there has not been apparent to me some insuperable obstacle to closed reduction. Therefore, if we are unable to secure reduction or to maintain it in the younger cases, even as young as two or three years of age, we should not hesitate to do an open operation. In regard to the time at which bloodless reduction should be attempted, I most heartily disagree with those who advise that we wait until the child begins to walk before reduction is attempted. This opinion is based upon the laws of Wolff and Roux, with which you are familiar. The normal architecture of the bony structures in the hip joint would be re-established, according to Wolff's law, only in case these structures bear normal relation to one another. There cannot be this normal relation unless the hip is in the socket. In the second place, according to Roux, we cannot have a normal development of any structure unless we have normal function of these structures. Therefore, the earlier the head of the femur is placed in the socket, the earlier its normal function begins and the earlier the natural development of the structures of the hip go hand in hand with function. If the hip remains for several years out of the socket, we cannot expect either natural development or natural architecture of the parts involved.

In the past five years I have operated on twenty-seven individuals over twelve years of age. On twenty-one of these I made operation on one hip only, and in seven I operated on both hips, making a total of thirty-four operations.

We aim to secure stability and mobility of the hip joint and freedom from pain. If the patient has a single dislocation, stability and freedom from pain are of much more moment than mobility, but if the dislocation be double we must have good motion in one hip at least. Therefore, I never operate on the second hip until we have secured satisfactory motion in the first one operated upon.

The slides which I shall show you illustrate the various methods of operation which have been employed to suit the different conditions which are present. In the younger cases it has been sufficient to remove the fibrous tissue which fills up the acetabulum, to replace the head within the acetabulum, and resuture the capsule. In other cases this has been done, and in addition the upper margin of the acetabulum has been enlarged by wedging downward and forward the acetabular rim. In other cases with but little acetabulum present, a bone flap has been turned down above the replaced head and held in position by pieces of bone taken from the side of the pelvis or from the crest of the ilium. In older cases it has been found that there is no acetabulum present at all, and it is deemed unwise in these older cases to attempt to replace the head at the site of the original acetabulum, as too much tension is thus made, which may lead to ankylosis of

the hip; but the head after being exposed in the wound is brought as far forward and downward as it will go without undue tension. This is usually, in older cases, at a point just below and behind the inferior spine of the ilium. Here a shallow excavation is made in the pelvis, sufficient to keep the head from sliding up when the thigh is abducted at about twenty degrees. A bone flap is then turned down in the manner described. It is thought desirable to get the head well forward rather than to bring it too far down. As we bring it forward we restore the normal weight-bearing axis of the body more nearly to the normal, whereas the shortening which is due to the elevation is not nearly so important.

In some cases there is found a shallow acetabulum with the head riding on the upper margin of it. There is subluxation rather than complete dislocation of the hip. The patients of this type have weak and often painful hips. In this type of case it may not be necessary even to open the capsule, but simply press the head a little farther forward and downward and turn down the bone flap above and behind it. In the two cases shown by Dr. Allison there seems to be this type of acetabulum. It appears to be too small and too shallow to hold the head firmly. I rather suspect that while reduction has been secured the patients may have weak or even painful hips eventually.

In the cases operated on very many variations have been observed in the size and shape of the acetabulum, head and neck, and I shall not take the time here to enumerate them.

My impression, as the result of this work, has been that in our treatment of dislocation of the hip we should replace the hip by bloodless reduction practically as soon as diagnosis of dislocation has been made. Bloodless reduction and maintenance of reduction may be efficiently accomplished by various methods and we do not at this time particularly need the introduction of new methods of bloodless reduction. No matter what method is employed a certain percentage of cases will show unsatisfactory results. On these cases, as soon as we are convinced of failure by bloodless method, we should employ the open method of operation. The older cases of dislocation should not be considered hopeless, as we may, by operative means, secure certainly a stable hip in all cases and usually also a movable hip which is free of pain.

Finally, we should not become so devoted to either bloodless or open reduction as to be unwilling to employ the other method, and we should not allow a patient under our care to grow up with congenital dislocation of the hip and reach such a stage as to suffer from pain and disability so great as to prevent her earning a livelihood.

Dr. Frank Dickson, Kansas City, Mo.: Dr. Allison said in his paper that the subject he was considering was the reduction of old congenital hips, meaning by that the reduction in cases that had reached the adult age and beyond. The problem that you have to answer in these cases, as Dr. Gill and Dr. Allison have said, is to give the individual a stable hip, a movable hip, and it is possible to give them both of these things by operative procedure at the proper time. Dr. Allison's procedure is one which involves the replacing of the head in an old acetabulum and to accomplish this there seem to me to be two factors which have to be considered, first, the relationship between the capacity of the acetabulum and the size of the head. In most of the hips I have opened there seemed to me to be a great disparity between the size of the acetabulum and the size of the head, though I think there are a certain percentage of them in which after the acetabulum is cleaned out it is possible to put the head in the acetabulum. Dr. Allison was fortunate in both of his cases to have such an acetabulum. The second factor is a very important one, and that is the contracture of the soft parts,

as the result of the prolonged displacement of the head. Dr. Allison has emphasized very properly this difficulty. The shortened muscles, shortened capsule, and shortened fascia around this joint make it extremely difficult to replace the head in the old acetabulum, so much so that it is my firm belief that it has to be done by main force at the time of operation, but it should not be done because we all know that every one who has done that has found after a time deformity of the head and ankylosis of the joint. This ankylosis occurs as the result of the tremendous pressure which is exerted by these shortened structures on the head when it is forced back in the acetabulum. It seems to me Dr. Allison has answered this question. It is not by main force that he reduces the head and maintains it there, but it is by loosening up of everything so that the head slips into the acetabulum and remains there without great pressure. It seems to me with this type of procedure it is perfectly safe to put the head back into the acetabulum with every expectation of getting a movable and stable hip. I do not think it can be done at one operation. I think his method of doing it in two stages is the only way it can be accomplished. My own experience is that if some such procedure is not done we are going to have far from satisfactory results.

From the point of view of favorable conditions I should think that the procedure described here today should be successful The two points that I would like to emphasize are, first, the impracticability of putting the head back into the acetabulum unless you do a very wide freeing up so that it will not have tension on the head after it goes in. The second point is one which Dr. Allison emphasized, that it should not be done in all cases. As in every operation, the cases should be selected and the patient must be prepared to go through a severe procedure and sometimes a rather stormy convalescence. I believe any of these operations done on adults for painful old dislocation of the hip should be done with the same amount of care that you would exercise in any serious surgical procedure. I think the ability of the individual to stand the strain is a very important factor in the success. The drawback is that you have to do two operations. You may say it is not a risk, but there is in my opinion a certain amount of danger in going into a bone or joint a second time. I think the resistance is not so great, and therefore I feel we should have very good reasons for advocating two such operations on the hip joint.

Dr. Walter Truslow, Brooklyn, N. Y.: Will Dr. Allison tell us whether the change in the angle occurred after the second operation?

Dr. Nathaniel Allison, Boston, Mass. (closing the discussion): In the second case,—that of the young man, age 18, it was necessary to do an osteotomy three months after the reduction of the hip in order to correct the extreme internal rotation of the femur. In this case three operations were done: (1) freeing the hip; (2) reduction of the hip; (3) osteotomy of the neck of the femur.

The question asked by Dr. Baer as to the fate of the separated lesser trochanter may be answered by pointing out that the X-ray photographs show the lesser trochanter reunited before the last operation was done.

PSEUDARTHROSIS OF THE TIBIA IN CHILDREN.*

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Pseudarthrosis or non-union of fractures fortunately is rare. The condition may be defined as a state in which there is no attempt at repair. It is particularly difficult to deal with at any period of life, but in infancy and childhood it may be included among the most difficult that the surgeon is called on to treat. The usual situation in the tibia is at the juncture of the lower with the upper two-thirds of the shaft.

There is very little to be found in English or American literature on the subject, and we must turn to Continental writings, most of which concern the purely congenital types of the deformity. Gasne's classification of the congenital type in the tibia consists of four sub-groups: (1) well marked anterior angular projection, but no fracture at birth; (2) the same as group one, but with the development of pseudarthrosis after slight trauma, or after an operation to correct the deformity; (3) pseudarthrosis present since birth; and (4) an unaccountable condition in which at birth the child appears normal, but, following slight trauma, a fracture occurs which develops into pseudarthrosis. Codivilla classifies them rather more broadly under three groups, basing his classification on morphologic and radiologic data: (1) the usual anterior angular deformity, at the apex of which is a transparent or rarefied area as shown by the x-ray; the fibula is curved, although the rarefaction of the bone itself is absent; (2) typical pseudarthrosis; the lower fragment often develops at its upper end, according to Codivilla, an articulating head which fits into a sort of glenoid fossa formed by the upper fragment; and (3) a great exaggeration of the condition in groups one and two, a large congenital loss of bony substance in both the tibia and fibula.

The cause of the development of such angulation and the reason why the fracture, when present, fails to unite are not known, and naturally many theories have been advanced. Frattin believed that intra-uterine pressure, due to amniotic cords or adhesions, might well be a factor.

* Read before the American Orthopedic Association, Baltimore, Maryland, May 15-17, 1924.

Codivilla believed that an embryonal lack of development due to the inactivity of certain cells was the cause, arguing that a congenital lack of development of the nutrient artery could very readily so starve the bone cells that their normal growth and activities would be inhibited. He called attention to the fact that in the upper fragment the surrounding muscles and tissues, with their free blood supply, would carry blood by collateral channels to this portion of the bone, but that the lower fragment is not so fortunately situated, for the surrounding tissues are mostly nonvascular. Bassetta had the opportunity to examine a fetus fourteen weeks old and found pseudarthrosis in the lower third of the right leg. In the space between the ends of the bone there was a large blood clot, a net of fibrin, and a few stellar connective-tissue cells. Microscopic examination demonstrated that the cells attached to the upper fragment had taken on some of the characteristics and the structure of bone cells. The nutrient artery was not mentioned, but Bassetta's finding at least tends to confirm Codivilla's that the upper fragment is better supplied with blood. Children with this condition usually are normal except for this deformity, and a local deficiency rather than a constitutional cause is indicated. On such a basis the theory of a congenital deficiency in the circulation to the bone is perhaps the most acceptable. Nové-Josserand called attention to the fact that the fracture may be lower than the usual site, being in the shaft at the juncture of the lower one-fourth with the upper three-fourths, and noted the fibrous character and inactivity of the marrow. Such a condition would lead more readily to fracture, to a poor degree of reparative power, and to failure to unite. Sperling, Haudeck, and Nové-Josserand reported that microscopic examination of their specimens revealed local irritation with round-cell infiltrations.

The treatment of these cases is quite as unsatisfactory as the search for the cause. It is with a feeling akin to chagrin concerning one's poor results that one reads an article such as that recently published by Dejarie and Perrin, in which they report five cases and three successes; two in the remarkably short time of two months and one in five or six months. They used the osteoperiosteal method without resection of bone and without opening the medullary cavity.

The various operations may be grouped under four headings: (1) The Italian method used by Codivilla and Reichel, consisting of a cutaneous osteoperiosteal pedunculated graft from the healthy tibia to the fracture, allowing sufficient time for the transplant to become adherent before severing the pedicle of the flap. This is a tedious process, Reichel's patient being fifteen months in fixation, Codivilla's eleven months, and

Nové-Josserand's eight months. (2) The method of Albee, using the inlay graft. Theoretically this would be the method of choice, particularly if there is loss of substance, but it has been most disappointing in cases of congenital pseudarthrosis. (3) The osteoperiosteal graft (Delangière), and the plastic osteoperiosteal methods, limited largely to cases in which the fragments are more or less in contact. (4) Massive graft. The unsatisfactory results are demonstrated by the fact that such an accomplished surgeon as Putti, at the last French Congress of Surgery, reported thirteen cases with eleven failures.

The basis for this paper is the study of nineteen cases of pseudarthrosis of the tibia developing in children. These cases fall readily into three groups: (1) cases in which the fracture was discovered at birth, or within a few days of birth; (2) cases in which the fractures were sustained in infancy or early childhood, that is, from three months to five years of age; and (3) cases in which the fractures were sustained in middle or late childhood, six to fourteen years. Definitely congenital cases in which there is absence of bone are not included.

GROUP 1. FIVE CASES

Case 1 (A118953) J. B. A normal appearing boy, aged seven years, was seen in November, 1914. A fracture in the lower one-third of the left tibia was noted a few days after birth. Labor and delivery had been normal. The child had been operated on at his home, a metal plate being applied, which was removed later because non-union persisted.

Typical pseudarthrosis of both tibia and fibula, with marked mobility, and outward and forward angulation were found. There was shortening of 7.5 cm., and the bone ends were overlapped and atrophic. The fragments were exposed and dissected loose, the fibrous tissue was removed, and a metal peg put through the os calcis to provide extension. The child was put to bed with extension for three weeks, when a plaster of Paris cast was applied. Persistent bronchitis prevented further surgery at that time. He was brought back again in six months and an inlay bone grafting operation performed.

The operation was satisfactory technically. Family economic conditions made it necessary to take the child home after three months. The family physician removed the cast after another three months and reported union complete. The patient was lost sight of and all was thought to be well, but several years later an answer to an inquiry brought the information that the fracture was still ununited, and that there was an extensive shortening. What was thought to be union evidently melted away to form a pseudarthrosis again. Perhaps if prolonged protection with a walking caliper had been insisted on, the result might have been different.

Case 2 (A400448) W. H. A boy, aged five years, was examined in August, 1922. A fracture in the lower one-third of the left leg had been noted at birth. The delivery had been instrumental. Two operations had been performed at home (Fig. 1).

The child had a draining sinus, and at exploration a silver wire was removed.

He returned November 10, 1923, and a large piece of bone was removed from his mother's leg, the blood grouping being satisfactory, and used to bridge the fracture line. The bone was put on as a massive graft and held in place by beef bone screws. Osteoperiosteal pieces were also placed around the fracture line. On the fourteenth day the child's temperature rose and drainage occurred. The graft was left in place until March 15, 1924, when it was removed (Fig. 2). A feeble attempt at union was present.

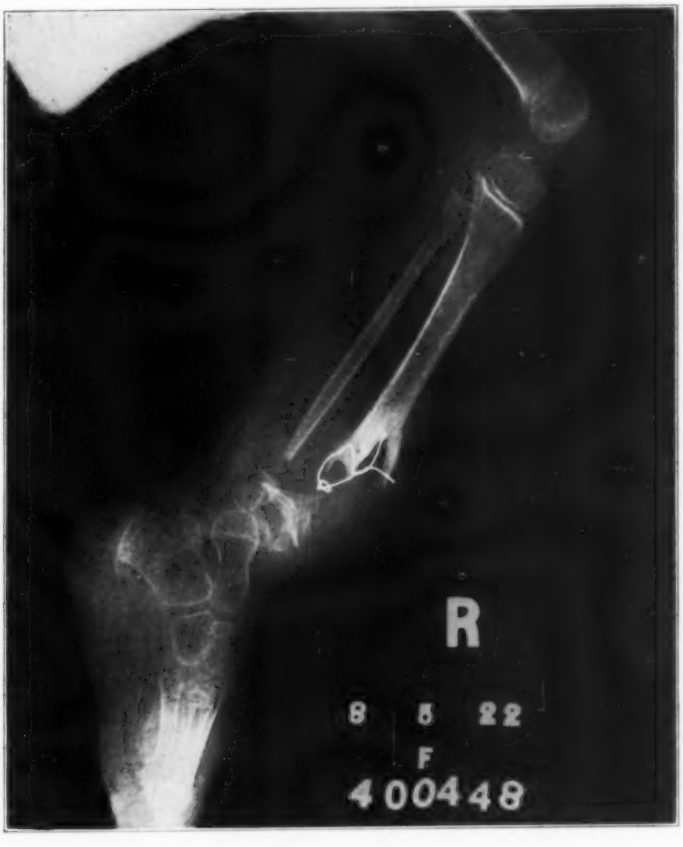

FIG. 1

(CASE A400448.) Pseudarthrosis since birth.

CASE 3 (A332591) M. J. O. A girl, aged two years, was examined in the clinic in June, 1920. At birth there was considerable bowing of both legs, the left one being worse. The family physician manipulated the leg about the fourth day, and after this the child cried with pain when the leg was touched. At eight months a consulting

physician diagnosed a fracture of the tibia in the lower third. When the child was eleven months old an open operation for the fracture was performed, the bones being sutured together with catgut. Non-union resulted.

FIG. 2

(CASE A400448.) Six months after homogenous graft. Much new bone, but not yet solid.

At the clinic a pseudarthrosis of the left tibia at the juncture of the lower and middle third with considerable atrophy of the fibula was found. The child's general condition was not of the best and there was a suspicion of rickets. The hemoglobin was 55 per cent. Operation was suggested, but not urged. A special diet and tonics were prescribed and the child dismissed from observation.

CASE 4 (A327842) R. G. B. A baby boy, aged six months, was examined in the clinic in August, 1920. The fourth day after birth the mother noticed a fracture in the lower third of the left leg. The delivery had been instrumental.

At the clinic a pseudarthrosis of the lower third of tibia and fibula was found. Operation was not advised because the baby was too young.

CASE 5 (A404253) W. L. A boy, aged three and one-half years, was examined in September, 1922. He had been born with an angular deformity in the lower half of the left leg. When he was twenty-one months old the bones had been fractured, and a plaster of Paris cast applied, but no union developed. Several other operations were performed elsewhere without union.

Examination revealed a very evident pseudarthrosis at the lower and middle third of the tibia and fibula. The difficulty of surgical procedure was explained to the parents, and operation was not performed. A splint was applied and the child was brought to the clinic for observation from time to time. He has been seen several times since then. At present he is wearing a walking caliper, and while it cannot be determined that union is developing, nevertheless the marked mobility at the site of fracture is disappearing.

Of the patients in Group 1, therefore, two were operated on at the clinic, one was operated on elsewhere, and two were not operated on. So far as we know, all of them still have pseudarthrosis.

GROUP 2. EIGHT CASES

CASE 6 (A82640) W. P. A boy, aged eight years, was examined at the Mayo Clinic in 1913, and has been under our observation on and off since then. When he was two and one-half years old the right tibia was fractured at the juncture of the lower and middle third, and was treated conservatively. The leg was deformed and weaker, but it was thought to be solid. Three and one-half years later he twisted his ankle, and the roentgenogram disclosed non-union of the fracture. Then followed three operations at his home, in which wire and metal plates were used. The non-union persisted and the plates and wire were removed. Gradually the fracture seemed to tighten, only, however, again to develop mobility slowly.

Examination revealed distinct motion in the tibia, the fibula being united. A sliding inlay graft was used at this time and failed. In 1915 a piece from the opposite tibia was used as an inlay graft, without union. Late in 1923 another attempt was made to obtain union, this time by fracturing the fibula and remodeling the ends of the tibia. The extra bone in the fibula was used as two grafts, but a low grade infection followed; there is still slight drainage and the leg is not yet solid.

CASE 7 (A245036) R. S. A boy, aged two years, was examined in September, 1918. Six months before the left tibia had been broken at the lower and middle third, and had failed to unite under ordinary fixation.

Two operations were performed at the clinic; first the bone ends were exposed, freshened, and drilled; second, the fragments were freshened, and fixation provided by aid of beef bone screws through side to side apposition, all without union.

CASE 8 (A270347) W. B. A boy, aged fourteen years (a brother of the patient in Case 9), was examined in May, 1919. At the age of sixteen months, his leg was hurt and the complaint located there, although it was several months before a deformity

was noted and a fracture diagnosed. At the age of three years the deformity was corrected at home, the surgeon asserting that there had been a fracture with overlapping union. Following this operation union did not occur.

Examination revealed pseudarthrosis of both the tibia and fibula in the lower third. A bone graft from the upper fragment was slid down to bridge the fracture by taking a piece about 1 cm. in thickness and 10 cm. in length and fastening it with beef bone screws. The ultimate result is unknown, although at the time of dismissal union seemed quite firm.

Case 9 (A270348) Z. B. A girl, aged six years, was examined in May, 1919. When three years of age she had fallen and broken her right leg in the lower third. The fracture was not diagnosed until two or three months later, just as had happened with her brother. Soon the leg "flopped" about, showing typical pseudarthrosis.

At examination pseudarthrosis was found, both the tibia and fibula in the lower one-third being in a state of non-union. The fragments were exposed and freshened. Side-to-side apposition was obtained, and the bones held together with beef bone screws. Operative recovery was uneventful, but the ultimate result is unknown.

Case 10 (A268775) M. H. A girl, aged four years, was examined in May, 1919. Eight months before, the left leg had been injured, but fracture was not diagnosed until a month later. A metal plate with four screws was applied at her home without improvement. There was a typical pseudarthrosis at the juncture of the lower and middle third.

The metal plate was removed, but it was felt that the bones were too porotic for surgical procedure, and a walking plaster of Paris cast was applied, the child being encouraged to use the leg. In two months the fragments were exposed and side-to-side apposition obtained by aid of beef bone screws. No union resulted. Six months later a heterogenous bone graft from her brother, ten years of age, was used after it had been ascertained that his blood group was the same. We feared to risk pseudarthrosis in the other leg by removing a piece of bone. For six months conditions seemed most encouraging, and the child was dismissed from observation still wearing a cast. She returned in a few months with non-union. The roentgenogram revealed that the beef bone screws used to hold the graft were showing no signs of absorption, and the graft was absorbing and broken. The pseudarthrosis is still persistent.

Case 11 (A335478) G. F. A boy, aged four years, was examined in September, 1920. When two months old he had fallen from a chair. No trouble was noted for six weeks except that he used the leg cautiously. The family physician found an ununited fracture, and an operation was performed without success.

The child was healthy looking. His Wassermann reaction was negative, as was that of his father, but the mother, who was pregnant at the time, had a strongly positive inhibition reaction. Definite pseudarthrosis was present at the juncture of the lower and middle third of the left tibia and fibula. An operation was advised, but refused. The present condition of the patient is not known.

Case 12 (A35038[illegible]) V. C. A boy, aged four years, was examined in February, 1921. Angulation was noted when the child was six and one-half months old. At about the same time pseudarthrosis was noted.

Examination disclosed pseudarthrosis of the left tibia and fibula. There was considerable forward angulation, but two operations had been performed at home with

no result. We advised that the fracture be explored and that such tenotomies as would be necessary to restore position be made and a cast applied, but the patient was never brought back for operation.

Case 13 (A402606) D. B. A girl, aged eight years, was examined in August, 1922. When the child was five years old a bowing of the left leg was noted, and this gradually became worse. Six months later a fracture had been diagnosed, and the leg straightened. Finally a bone graft was applied at her home, but was a failure.

At the clinic operation was advised, but the child was referred back to her original surgeon.

Five of the eight patients in this group were operated on at the clinic without success. Two operated on elsewhere were referred back to their former surgeon. In one the parents refused operation because we could not assure them of a higher percentage of cures. The boy in Case 8, who was fourteen years old at the time of dismissal, two months after operation seemed to have union, but we hesitate to class him definitely as cured. He is the only one in this group that offered any hope of a good result when last seen.

GROUP 3. SIX CASES

Case 14 (A197825) J. A. P. A boy, aged eight years, was examined in June, 1917. When he was six years of age he jumped down some steps, breaking his right leg in the lower third. No union followed, and operation was performed a year later, with no result.

The roentgenogram showed a pseudarthrosis in the right tibia, the fibula being united. An open operation was performed, the ends of the bone were freshened and carefully lined up, and a cast applied. Union resulted.

Case 15 (A249219) H. L. A boy, aged twelve years, was examined in October, 1918. Three years before, he had injured his leg, although fracture was not diagnosed. A second injury, caused by falling into a badger hole and twisting the leg, led to a roentgenographic examination, which disclosed a fracture. The patient and his parents said that the leg had not been right since the first injury. Three operations elsewhere for non-union failed.

A metal plate was removed, and a sliding inlay reversible graft inserted. On the patient's dismissal, three months later, his condition looked very encouraging, but a communication two years later from the physician in charge stated that union broke down, and the father, becoming discouraged, had refused further attempts to obtain union and had had some one amputate the leg.

Case 16 (A236365) V. W. A boy, aged fifteen years, was examined in June, 1918. Seven years before, he had fractured the left tibia. No splints were applied and a marked deformity developed. Two operations had been performed elsewhere without improvement.

At examination 5 cm. of shortening of the leg was found; the fibula was united, though curved. The fracture was exposed and a metal plate removed (Fig. 3). The ends of the bone were freshened and wedged together, and a plaster of Paris cast applied with the bones in good alignment (Fig. 4). In three and one-half months the bone was firmly united. A recent communication states that the leg has given no further trouble.

CASE 17 (A200551) A. W. M. A man, aged twenty-one years, was examined in July, 1917. At the age of eleven years he had sustained a fracture of the left tibia in the lower third, that never united.

FIG. 3

(CASE A236365.) Boy aged fifteen years with pseudarthrosis seven years' duration.

The fibula was not broken, and was found to be markedly hypertrophied. There was a pseudarthrosis, however, in the lower third of the tibia. The deformity was corrected after the fracture of the fibula and the insertion of a sliding inlay graft across the fracture line on the tibia. Recovery was slow, but the leg remained straight and became solid.

CASE 18 (A277127) W. A. J. A man, aged thirty years, was examined in June, 1919. When he was thirteen years of age he had fractured his tibia and fibula in the upper third. Non-union resulted in the tibia. One year before, a bone grafting operation had been performed elsewhere without union.

Operation was performed, the sliding inlay method being used. Firm union resulted.

FIG. 4

(CASE A236365.) Contact of ends after freshening. In three and one-half months firmly united.

CASE 19 (A279058) M. G. A woman, aged twenty-one years, was examined in July, 1919. She had fractured her leg seven years before. She had had five operations elsewhere. At one time union had seemed firm, but it broke down under use and the pseudarthrosis was again present.

A fracture of the tibia and fibula in the lower third with a typical pseudarthrosis and shortening of 6.25 cm. were found (Fig. 5). The fragments were exposed and freshened, and 12.5 cm. of the fibula removed from the upper fragment. The cortex on one side of both fragments of the tibia was denuded and a massive graft applied,

FIG. 5

(CASE A279058.) Woman aged twenty-one, with pseudarthrosis of seven years' duration.

which was held in place with beef bone screws (Fig. 6). Union followed, but the leg was protected with a walking caliper for eighteen months. There is now only 1.8 cm. of shortening and the leg is perfectly normal as to function.

The six patients in this group were operated on at the clinic. Only one had not been operated on before. Five operations were successful and one was a failure.

FIG. 6

(CASE A279058.) Union secured by free transplantation of a portion of the fibula.

SUMMARY

All of the five cases in Group 1 were in reality congenital, or birth fractures. So far as we know, the fractures are all ununited. The eight cases in Group 2 were fractures of infancy or early childhood. Probably thus far none of these are united. Therefore, so far as treatment is concerned, this group is just as unsatisfactory as Group 1. In some of the patients in Group 2, particularly in Cases 8 and 9, brother and sister, there may be hereditary factors. Seven of the thirteen patients in Groups 1 and 2 were operated on at the Clinic without success. However, two patients have not been traced.

The six patients in Group 3 all sustained their fractures in middle or late childhood. In Case 15, in which there was failure, the patient was operated on under the age of puberty, the remainder were operated on after puberty, and all obtained union. In Case 6 (Group 2) a second operation was performed after puberty, with failure; a low grade infection may have been the cause.

In a paper I published last year in which forty-four cases of non-union in the tibia, with eight failures, were reported, six of the failures were in fractures sustained in childhood. The percentage of success for the fractures sustained in childhood was 25. The percentage of success for the entire group was 81.8. If the six cases in children were omitted, the percentage of successes in the adult would be raised to 94.

Syphilis was ruled out in all cases; however, in one instance the mother gave a positive Wassermann reaction, but the father and the patient gave negative reaction. This patient cannot be traced. In some of the recent cases analyses of the blood were carried out and the calcium, magnesium, and phosphorus contents were found to be normal.

CONCLUSIONS

1. In Group 1 there were five congenital cases, and in Group 2 eight cases of fracture acquired in infancy or early childhood. Seven patients were operated on without a single successful result.

2. In Group 3, in which the fractures were sustained in middle or late childhood, six patients were operated on, with five cures. The one who failed to obtain union was operated on under puberty.

3. From a review of our cases my impression is that with prolonged fixation and support (one or two years) in a walking caliper, in two cases (Cases 1 and 15) the union that was secured might have been maintained. The later in childhood the fracture is sustained the better the prognosis after surgery.

4. Amputation is not justifiable, for if these children are carried beyond puberty their fractures become more amenable to surgery, and they will have somewhat more nearly the percentage of good results that the adult has with ordinary pseudarthrosis.

5. Pseudarthrosis, congenital or acquired in infancy or early childhood, is extremely intractable. The condition is sufficiently rare to make the experience of any one man rather meager. From the recent literature one would judge that the osteoperiosteal grafts were the best. My experience leaves me without choice, except that in treating a rather large

number of non-unions in adults I found the larger massive autogenous grafts to give the best results, and see no reason why the same should not apply to children.

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DISCUSSION

Dr. Fred H. Albee, New York City: I have done a large number of cases of ununited fractures of infancy which Dr. Henderson reports and they are certainly a very difficult type of case. The pathology is quite different from this type of case in older individuals. In the adult we have two types of cases. The frequent case is the club-ended fragments. The rarer case is the conical-ended fragments. In the congenital type in young children a very large percentage of the fragments are extremely conical in shape. I believe in this type of case the surgeon should not be discouraged by one failure. I recall a case which Dr. Williams referred to me in which five operations to secure union had been done, three of them bone grafts. The case was that of a tibia in a young child. As a result of a very carefully executed operation solid union was obtained. This case has been followed for seven years now and the result is excellent. I cite this as one of the most unfavorable cases of this type in which union was obtained by the first inlay operation, although several operations had preceded it.

A large number of these cases have come under my observation. In order to get the most favorable massive graft I take a long wedge-shaped piece from each end of the bone and then split each fragment end so that a double wedge-ended graft of much larger diameter can be used. The bone is very osteoporotic, especially just back from the end of the fragments, and for this reason the bone bends very satisfactorily when split, thus allowing a wider wedge cavity to receive the graft. The size and strength of the graft is most important in all cases of non-union in childhood. An inlay graft is the most favorable type of graft in such cases because by its mortise it brings about the most complete immobilization and also the most ideal environment as far as blood supply is concerned.

Dr. J. T. Rugh, Philadelphia, Pa.: I have had four of these cases. The first one I had to deal with was of the congenital type, in a boy who was a mild grade of cretin.

I operated upon him four different times and watched him until he was ten or eleven years of age. I treated him through most of those years with thyroid. In order to secure union in the fracture of the tibia in one of the operations, I had to fracture the fibula so as to secure shortening of that. Subsequently absorption in the fibula took place and the ultimate result was an amputation in the hands of one of the surgeons.

At the end of a week he attempted to demonstrate to the class a case of "union by first intention" and when the sutures in the soft parts were cut, the flaps fell apart. There was no regeneration in the soft parts, though ultimately closure took place by granulation.

Another case that I still have under treatment was one in which there was a congenital bone cyst, with angulation of the tibia. Fracture took place at this point. I placed a large graft from the father's tibia in the child and that graft is still in place and union was taking place, but within the past three months the child had a fall and broke the graft loose from the upper fragment of the tibia. I do not know what will be the result in this case. My two other cases in which I have done massive bone grafts have both resulted in failure.

DR. M. S. HENDERSON, Rochester, Minn. (closing the discussion): Dr. Albee mentioned the poor character of the bone fragments. This is common, and also the bone marrow is fibrous. The one point that should be borne in mind and which needs emphasis is prolonged fixation. One of my cases had union that was apparently firm, but about one year after the operation the leg broke again. The father took the boy to another surgeon, who said further surgery to obtain union was useless and amputated the leg. I think if I had insisted on the boy wearing a caliper splint for eighteen months the second fracture would not have occurred.

ANALYSIS OF CONGENITAL HIPS OBSERVED IN PRIVATE PRACTICE

BY CARL C. CHATTERTON, M.D., AND ALBERT E. FLAGSTAD, M.D., ST. PAUL, MINN.

A great deal of interest has been manifested during the last several years on the true status of congenital dislocation of the hips. Since the report of the Hip Commission, and Dr. Ridlon's paper on his experience with congenital hips, the profession has been stimulated to investigate its results in the treatment of this condition.

It was with this in mind that we examined the records of Drs. Gillette and Chatterton and in going over the case records we found that possibly the best manner to present the results was to outline each case. The three hundred and forty-nine cases were tabulated in the manner as illustrated: the photograph represents only twenty-five of the three hundred and forty-nine cases so outlined.

No attempt was made to obtain information through correspondence, as a number of the case records date back many years. It seemed more feasible to record the period under observation and date of last report. In the main, the outline is true as to age, hips, birth, and family history, treatment, complications, period under observation, and last report. The operative results in main are true. The data of the very early cases is somewhat abbreviated; the period of observation in a few of these cases is very short. In many of the early cases the patient returned years later, and the condition on last report was always taken as the final result.

In all of the cases, arrangement at the beginning of treatment was made to continue until the result was satisfactory, without additional fee. This made it possible to observe results over a comparatively long period, and to turn apparently poor results on first operations into good or perfect results after second or third operations. It is interesting to note that with very few exceptions the parents co-operated well, and that the patient returned when asked to report or when not doing well.

Our desire in this paper is to analyze the cases that have been observed and to present all the facts concerning them in as short and concise a manner as possible. The success or failure of treatment has been recorded impartially from the available data at hand, and the various phases of the outline analyzed in their respective order.

METHOD OF REDUCTION

The method of reduction used in this series of cases is very similar to Ridlon's method, except that in many cases the adductors were pounded or massaged. If the adductors are not especially contracted, a Ridlon reduction is attempted. After reduction, the leg is put up in 90-90 position with a sheet-wadding dressing and a spica cast; in double dislocations both hips and knees included in cast; in single dislocations only the affected hip and knee, except in cases where the opposite socket is shallow. Occasionally it is necessary to put the leg up in extreme internal rotation. This, however, as a rule, is not done before the application of the second cast. Occasionally the flexion angle is more than 90 degrees; in a few the hips were put in an axillary position. The angle of fixation is determined by the depth of the acetabulum and the ease or difficulty with which the hip slips out. After a few days, depending somewhat upon the shock of operation, the patient is permitted to be up and about, wearing the cast. At the end of three months, sometimes before, depending upon the condition of the plaster, the cast is removed and a new one applied, bringing the leg down a few degrees and allowing the knee to be free. After another interval of three or four months the plaster is removed, and if by radiogram and manipulation the hip seems to be fixed in the socket, the patient is allowed to go without cast. During the first year the patient is seen about four times, the parents are instructed to watch the patient closely, and if at any time the patient begins to walk poorly they are to report at once. During the second year the patient is seen several times, and thereafter at least once a year for an indefinite period. During these visits X-ray pictures are taken, thorough examination made, recording the difference in length, etc. In our experience we have found that parents carry out instructions quite carefully and report as a rule as soon as the child begins to walk poorly or when in their opinion the child does not improve. In the majority of cases a year or more is required before the legs come down into normal position. During this period massage and gentle manipulation help to a considerable degree. We have also found the use of a Kiddie car of value during the cast period. In private practice it has been found almost impossible to carry out the Denucé method of after treatment, although this method of reduction has been used in several cases. No open operations were done in this series of cases, although in recent years several patients have been told that this would be the method of choice.

KEY TO TABLE

P: Period. Report is divided into four 5-year periods, except period 4, which is seven years although not all of 1922 cases reported.

FV: Date of first visit.

Age: At time of first visit.

Symptoms: Briefly complaint of patient or parents at first visit.

Hip: R right, *L* left, *Bi* bilateral; *1* single, unknown.

Fam. H.: Family history with regards tuberculosis, cancer, insanity, and congenital deformities.

BH: Birth history with reference to type of birth, length of labor, instrumental, or anomalies.

Dif. L.: Difference in length of limbs at time of first visit; second *Dif. L.* refers to post-operative difference.

X: X-rays of case.

L-R: Lorenz-Ridlon as described.

Period: Time under observation.

Casts: Number of casts and length of time worn. 1:6 meaning one cast worn six months; 2:av. 5 meaning two casts averaging five months each.

Complic: Refers to post-operative complications, such as limitation of motion, paralysis, fracture, circulatory disturbances. Age and disease not considered as complications.

Last report: Date and condition at this time with special reference to operative cases.

P'less: Painless.

Rach: Rachitic.

Gen. Nut: General nutrition.

Lmp: Limp.

": Before case indicates other congenital hip in family.

W: Waddle.

ILLUSTRATIONS

P	FV	Case	Name	Sex	Age	Hip	Symptoms	Fam H	B H	Dif L	X-r	Operati
4	2-16	101	AGH	M	4	Bi	Waddle	Neg	Neg		X	2-26-16
4	4-17	102	MH	F	10	Bi	Waddle	---	Neg.	R¼	X	Not adv
4	2-17	103	LWH	F	2½	L	P'less lmp	Neg	Neg	---	X	Dr. Re duced, see hi
4	7-18	104	FH	F	3	L	Lameness	Neg	Neg	---	X	7-24-18
3	10-15	105	JH	F	2	L	Lameness late walk	Neg	Neg		X	11-5-15 11-27-1
4	11-16	106	AWH	M	2½	-	In cast	Neg	Neg	---	X	Adv. c ue Dr.
3	3-15	107	WH	F	3½	Bi	Waddle	---	---	---	X	4-20-15
2	4-09	108	LH	F	2½	R	Lameness	---	---	---	---	4-28-09 3-16-17
4	4-16	109	WH	F	2½	Bi	Seen at B; Lordosis-W	---	---	---	X	5-3-16
3	2-13	110	NH	F	1½	R	Noted at walking	Neg	Neg	---	X	State Ret 6
2	9-08	111	ChH	F	4	R	Lameness	---	---	Pres	---	L-R
1	6-03	112	JOH	F	2	Bi	Waddle	---	---	---	---	L-R 190 in 190
2	7-08	113	LJH	F	6	l	Limp	---	---	---	---	L-R
2	6-10	114	EMH	F	5	L	Limp; late walk	---	---	1½	X	L-R
2	6-10	115	RH	M	5	R	-----	---	---	1½	X	6-28-10
2	9-09	116	HH	F	13	R	-----	---	---	Mrkd	---	Adv lif shoe
2	7-06	117	JFH	M	1½	Bi	-----	---	---	L high	X	Oct 07
4	9-21	118	JHH	F	-6	L	P'less lmp on walking	Neg	Neg	¾	X	Sept 2
3	7-12	119	EH	M	1-10m	R	Limp	---	---	1	X	L-R
3	11-11	120	DJH	F	19m	L		---	---	---	X	6-22-12 8-1-14
2	3-09	121	AH	F	2	R	P'less lmp	Neg	Neg	Mrkd	X	L-R
4	6-20	122	NH	F	11	L	P'less lmp	Neg	Neg	1½	X	8-28-20
4	9-18	123	FCH	F	23m	L	P'less lmp	Neg	Neg Art fed	¾	X	7-28-20
4	10-19	124	JH	F	5	Bi	Lameness	Neg	Neg	¾	X	10-9-19

LINE OF CASES

Operati	lt	Dif L	Period	#Op	#Casts	Complic	Last report
2-26-16	in Ant Transp	¼	2-16:11-20	1	2:9mos	No	11-20 Good
Not adv	ing done	---	1 visit	No	No	No	6-17
Dr. Re uced, ee hi 7-24-16	ing done	---	1 visit	No	No	No	2-17
	, riding high	¼	7-18:4-22	1	1:5mos	No	4-22 Good
11-5-15 11-27-1	or 10 mos. ood after 2 yrs	¼	10-15:6-19	2	4:5mos each	No	6-19 Good
dv. co e Dr. -20-15	ing done	---	1 visit	No	No	No	11-16
	ect in socket	None	4-15:10-16	1	3:8mos	No	10-16 Perfect
-28-09 -16-17	everal mos., out. Transp fixed	2¼ ¼	4-09:7-17	2	4:av 6mos	No	Ant Tr. Good
-3-16	ect in socket	---	4-16:1-18	1	2:6mos	No	1-18 Perfect
tate H et 6 m	ing done	---	1 visit	No	No	No	2-13
-R		---	9-08:5-09	1	1:6mo	No	5-09 Good
-R 190 n 190	or brace adv	---	6-03:9-09	1	---	No	10-12 Op failure
-R	ocket	---	7-08:2-09	1	1:8mos.	No	2-09 Good when cast removed
-R	ocket good coxa vara	1	6-10:11-14	1	1:6mos	No	11-14 Fairly good
-28-10	Transp, Good	---	6-10:12-10	1	2:6mos	No	12-10 Good when cast removed
dv lif hoe	ing done	---	Dr. Forbes op- 4 yrs before		No	No	9-09 Adv shoe
ct 07	, L out	L short	10-07:6-19	1	---	L out	Right perfect Left failure
ept 21	ect insocket	---	9-21:9-22	1	2:6mos	No	9-22 Perfect
-R	ect in socket	---	7-12:1-14	1	1:3½m	No	1-14 Perfect
-22-12 -1-14 -R	nd out ect in socket ect in socket	---	11-11:5-17	2	4:4mos each	No	5-17 Perfect
		---	3-09:2-16	1	3:10mo	No	2-16 Perfect
-28-20	ocket good	1	8-20:1-22	1	1:5mos	No	1-22 Good
-28-20	ect in socket	None	7-20:2-22	1	2:5mos	No	2-22 Perfect
0-9-19	perf in socket	---	10-19:2-21	1	2:5mos	No	2-21 Perfect

ANALYSIS OF 349 CASES

PERIODS:

Period 1: 1900-1905 inclusive 43 cases, or 12 per cent. of total.
Period 2: 1905-1910 inclusive 57 cases, or 16 per cent. of total.
Period 3: 1910-1915 inclusive 96 cases, or 27 per cent. of total.
Period 4: 1915-1922 inclusive 151 cases, or 44 per cent. of total.
Period unknown: 2 cases, or 6/10 per cent.

SEX:

Male: 61 cases, or 17 per cent. of total.
Female: 276 cases or 80 per cent. of total.
Unknown: 12 cases or 3 per cent. of total.
Hips dislocated:
Right: 78 cases or 22 per cent. of total.
Left: 108 cases or 31 per cent. of total.
Bilateral: 112 cases, or 32 per cent of total.
Single unknown: 41 cases, or 12 per cent. of total.
Unknown: 10 cases, or 3 per cent. of total.
Total cases 349. Total hips 461.

AGE:

4 cases under 1 year: 5, 7, 9, and 10 months, respectively.
30 cases between 1 and 2 years, greatest number of which were 1½ years.
28 cases 2 years.
21 cases between 2 and 3 years.
21 cases 3 years.
8 cases between 3 and 4 years.
32 cases 4 years.
2 cases between 4 and 5 years.
27 cases 5 years.
4 cases between 5 and 6 years.
14 cases 6 years.
14 cases 7 years.
3 cases between 7 and 8 years.
6 cases 8 years.
1 case between 8 and 9 years.
14 cases 9 years.
13 cases 10 years.
5 cases 11 years.
6 cases 12 years.
3 cases 13 years.
4 cases 14 years.
1 case each 18, 19, 20, 24, 27, 28, 30, 35, and 42 years.
4 cases 22 years.
2 cases 23 years.
2 cases 25 years.
42 cases age unknown.

Youngest case 5 months, oldest 42 years.
211 out of the 349 cases reported at six years or under.

SYMPTOMS:

104 cases in which no symptoms had been recorded, simply noted.
In 245 cases reported, most frequent subjective symptoms are painless limp, late walking, waddle, and increasing deformity. Objective signs are limp, waddle, Trendelenberg, and shortening.

RICKETS:

12 cases of rickets charted. There are, however, a considerable number more recorded, and further investigation of the records would probably bring the number up to 50 cases. In several instances operation was delayed until the rachitic condition had been cured.

DIFFERENCE IN LENGTH:

181 cases difference of length not recorded, most of these in the earlier periods. In some of the later cases measurement was made but not recorded.
156 cases reported shortening, as follows:
7 cases ¼ inch.
25 cases ½ inch.
22 cases 1 inch.
28 cases 1½ inch.
12 cases 2 inches.
1 case 2¼ inches.
4 cases 3 inches.
6 cases 2½ inches.
2 cases 3½ inches.
9 cases 1¼ inches.
9 cases 1¾ inches.
12 cases ¾ inch.
2 cases slight shortening.
17 cases considerable shortening.

FAMILY HISTORY:

5 cases of other congenital hips in family: 4 cases of two in family and 1 case of three in family.
Case 19 and 22, sisters.
Case 144 and 145, brother and sister.
Case 224 and 225, mother and son.
Case 323 and 324, sisters.
Case 295, 339 and 340, brother and two sisters.
3 cases reporting miscarriages: Case 95 two miscarriages, Case 216 two miscarriages, Case 156 six miscarriages (uterine fibroid).
1 case reporting marked difference in ages of parents, Case 17.
1 case 170 luetic.
1 case 99 father Pott's disease.
1 case 180 mother mental.

197 cases in which family history was negative. 137 cases in which family history not recorded but had been noted in most instances, and probably negative.

BIRTH HISTORY:

133 cases birth history not recorded, probably negative.
3 cases difficult labor: Case 17, 229, 308
4 cases hard and long: Case 86, 145, 150, 151.
5 cases instrumental: Case 24, 183, 309, 321, 346.
4 cases breech: Case 24, 181, 264, 290.
2 cases premature: Case 41, 306.
198 cases reported as negative.

OPERATIONS:

218 operations on 182 cases; 25 cases operated twice; 5 cases operated three times.

Results are classified as *Perfect in socket, Very good, Good, Fairly good, Fair,* and *Failure.* *Perfect in socket* refers to relationship of head to acetabulum, in all cases perfect functional and in most cases perfect anatomical result. *Very good* refers to perfect functional result with slight anatomical distortion. *Good,* as a rule, refers to perfect functional result with some anatomic deformity, *i.e.* coxa vara, anterior transposition, rotation, or shortening. *Fairly good* refers to good functional result, but increased anatomic distortion with shortening. *Fair* refers to some improvement as to position and function, but shortening and deformity more marked. *Failure* refers to failure to obtain reduction, or in bilateral cases reduction of one hip and failure to reduce the other. *Anterior transposition* refers to anatomic position without classification as to functional result. Above classifications made after roentgenographic examinations and physical findings.

67 cases recorded as Perfect, or 37 per cent. of total. (4 of these in cast.)
8 cases recorded as Very good, 4 per cent. of total.
40 cases recorded as Good, or 22 per cent. of total.
18 cases recorded as Good in A Tp., or 10 per cent. of total.
8 cases recorded as Fairly good, or 4 per cent. of total.
12 cases recorded as Fair, or 7 per cent. of total.
5 cases recorded as Anterior Transposition, or 2 per cent. of total.
24 cases recorded as Failures, or 13 per cent. of total.
115 cases, or 63 per cent. of total gave a perfect functional result.

Classification of failures

24 cases of failures as follows: 13, 50, 70, 82, 117, 126, 129, 139, 167, 191, 192, 202, 203, 206, 213, 222, 236, 256, 266, 270, 324, 331, 112, 10.

Period: 3 cases in Period 1; 8 cases in Period 2; 8 cases in Period 3; 5 cases in Period 4.

Age: 2 cases 1½ years; 6 cases 2 years; 1 case 3 years; 4 cases 4 years; 2 cases 5 years; 1 case 6 years; 1 case 8½ years; 3 cases 9 years; 2 cases 10 years; 1 case 11 years; 1 case 10 months.

Difference in length: 2 cases ½ inch; 3 cases 1½ inch; 1 case 1¼ inch; 1 case 1¾ inch; 1 case 2 inches; 1 case 3 inches.

Number of operations; in 21 cases one operation; in 3 cases two operations; in 2 cases operation was preceded by extension weight and pulley; in 2 cases failed to reduce after one hour's manipulation.

Two cases were operated upon by Dr. Ridlon: 206 and 266.

In 15 cases the period of observation was very short, only during the time cast was worn, eight or nine months.

Causes of failure in order of importance: 1. Period of observation too short, as in many cases second operation could have been performed. 2. Age: 7 cases were definitely poor operative risks because of age. Three of five cases in Period 4 were over age limit. Operative and after treatment improved since 1915; 79 per cent. of the failures were previous to this time.

Analysis of PERFECT, GOOD and FAIR hips:

PERFECT hips, 67 cases, classified according to hips:

25 cases, right hip.
25 cases, left hip.
14 cases, both hips.
3 cases, undesignated.

Total 67 cases—81 hips.

Ages of patient at time of reduction:

1 case, patient 1 year old.
12 cases, patient 1½ years old.
11 cases, patient 2 years old.
7 cases, patient 2½ years old.
9 cases, patient 3 years old.
5 cases, patient 3½ years old.
8 cases, patient 4 years old.
1 case, patient 4½ years old.
2 cases, patient 5 years old.
1 case, patient 5½ years old.
2 cases, patient 6 years old.
3 cases, patient 7 years old.
2 cases, patient 8 years old.
1 case, patient 11 years old.
2 cases, patient age not designated

Period under observation:

2 cases, 5 months after operation.
6 cases, 6 months after operation.
2 cases, 7 months after operation.
3 cases, 8 months after operation.
1 case, 9 months after operation.
(Or 14 cases under one year of observation.)
14 cases, 1 year after operation.
10 cases, 1½ years after operation.
8 cases, 2 years after operation.
2 cases, 2½ years after operation.
5 cases, 3 years after operation.
2 cases, 3½ years after operation.
2 cases, 4 years after operation.

2 cases, 5 years after operation.
1 case, 6½ years after operation.
4 cases, time not designated.
3 cases, still in cast.

Total 67 cases.

Average length of time in 60 out of 67 cases is 1⅔ years.

Most popular periods: 14 cases of 1 year; 10 cases of 1½ years; 8 cases of 2 years.

GOOD and FAIR hips:

Classified according to hips:

25 cases, right hip.
41 cases, left hip.
20 cases, both hips.
5 cases, undesignated.

Total 91 cases—111 hips.

Ages of patient at time of reduction:

No case, patient 1 year old.
7 cases, patient 1½ years old.
7 cases, patient 2 years old.
9 cases, patient 2½ years old.
16 cases, patient 3 years old.
1 case, patient 3½ years old.
15 cases, patient 4 years old.
1 case, patient 4½ years old.
11 cases, patient 5 years old.
3 cases, patient 5½ years old.
6 cases, patient 6 years old.
6 cases, patient 7 years old.
2 cases, patient 8 years old.
2 cases, patient 9 years old.
2 cases, patient 10 years old.
2 cases, patient 11 years old.
1 case, patient 12 years old.

Total 91 cases

Most popular ages: 16 cases of 3 years; 15 cases of 4 years; 11 cases of 5 years.

Period under observation:

2 cases, 5 months after operation.
1 case, 6 months after operation.
6 cases, 7 months after operaton.
4 cases, 8 months after operatiion.
2 cases, 9 months after operation.
2 cases, 10 months after operation.

(Or 17 cases under one year of observation.)
15 cases, 1 year after operation.
11 cases, 1½ years after operation.
10 cases, 2 years, after operation.
3 cases, 2½ years after operation.
4 cases, 3 years after operation.
5 cases, 3½ years after operation.
5 cases, 4 years after operation.
3 cases, 4½ years after operation.
2 cases, 5½ years after operation.
2 cases, 6 years after operation.
1 case, 6½ years after operation.
3 cases, 7 years after operation.
2 cases, 8 years after operation.
1 case, 9 years after operation.
1 case, 9½ years after operation
1 case, 11½ years after operat on.
2 cases, 12 years after operation.
3 cases, time not designated.

Total 91 cases

Average length of time under observation in 88 cases is 2.86 years.

Most popular periods: 15 cases of 1 year; 11 cases of 1½ years; 10 cases of 2 years

Casts:

183 cases in which casts were applied:
53 cases in which one cast was applied.
85 cases in which two casts were applied.
22 cases in which three casts were applied.
12 cases in which four casts were applied.
4 cases in which five casts were applied.
1 case in which six casts were applied.
6 cases in which number of casts not designated.

1-cast cases:
1 case, cast on 1 month.
2 cases, cast on 3 months.
1 case, cast on 3½ months.
3 cases, cast on 4 months.
8 cases, cast on 5 months.
23 cases, cast on 6 months.
3 cases, cast on 7 months.
3 cases, cast on 8 months.
1 case, cast on 9 months.
4 cases, casts not known.
4 cases, cast still on.

2-cast cases:
2 cases, casts on 4 months.
14 cases, casts on 5 months.
34 cases, casts on 6 months.
14 cases, casts on 7 months.
11 cases, casts on 8 months.
2 cases, casts on 9 months.
4 cases, casts on 10 months.
4 cases, casts not known.

3-cast cases:

2 cases, casts on 4 months.
2 cases, casts av. 4 months.
2 cases, casts on 5 months.
3 cases, casts on 6 months.
3 cases, casts on 7 months.
3 cases, casts on 8 months.
3 cases, casts on 9 months.
1 case, casts on 10 months.
3 cases, casts not known.

4-cast cases:

2 cases, casts av. 4 months.
1 case, casts on 5 months.
5 cases, casts on 6 months.
1 case, casts on 7 months.
1 case, casts on 8 months.
2 cases, casts not known.

5-cast cases:

1 case, casts av. 4 months.
2 cases, casts on 5 months.
1 case, casts on 6 months.

Summary of length of time casts worn:

66 cases of 6 months.
27 cases of 5 months.
21 cases of 7 months.
18 cases of 8 months.
12 cases of 4 months.
6 cases of 9 months.
5 cases of 10 months.
13 cases of not known.
4 cases of cast still on.
2 cases of 3 months.
1 case, of 3½ months.
1 case of 1 month.
7 cases not designated.

CASES NOT OPERATED:

There were 167 cases seen in which no operation was done. These may be classified as follows:

35 cases operation not advised and no treatment given. Ages in this group as follows:

1 case, 5 months.
3 cases, 7 years.
3 cases, 9 years.
8 cases, 10 years.
1 case, 11 years.
1 case, 12 years.
2 cases, 13 years.
3 cases, 14 years.
1 case, 17 years.
1 case, 18 years.
2 cases, 23 years.
1 case, 24 years.
1 case 27 years.
1 case, 35 years.
3 cases, Adults (Miss)
3 cases, undesignated.

31 cases, or 88 per cent., in this group definitely over age limit, 3 cases not designated.

38 cases in which supports were either advised or applied. Ages in this group as follows:

1 case, 8 years.
2 cases, 9 years.
1 case, 10 years.
2 cases, 11 years.
3 cases, 12 years.
3 cases, 13 years.
1 case, 14 years.
1 case, 16 years.
1 case, 17 years.
3 cases, 18 years.
1 case, 19 years.
1 case, 20 years.

2 cases, 22 years.	1 case, 30 years.
3 cases, 23 years.	1 case, 42 years.
2 cases, 25 years.	9 cases, undesignated.

29 cases, or 76 per cent., in this group definitely over age limit.

35 cases in which operation was advised but patient not operated upon—in the majority of these cases patient was seen only once.

35 cases undesignated as to disposal. However, the major part of these were one-visit; in many cases patient probably advised operation, according to age of patient.

4 cases in which operation was delayed because of rickets; patient did not return later for operation.

10 cases referred to the State Hospital.

1 case referred to the St. Paul Dispensary.

7 cases referred back to orthopaedic surgeon treating them.

2 cases in which extension weight and pulley applied and support given.

Age was definitely responsible for failure to operate in 60 of these 167 cases, or 35 per cent., of this group.

Comparison of reductions and failures by periods:

PERIOD I. Out of 11 cases 8 were reduced and 3 were failures, or percentage of reduction 72 per cent.

Cases reduced classified as follows:

4 Perfect.	1 Good.
1 Very good.	2 Fair.

6 cases out of 8 with perfect functional result, or percentage of 75 per cent.

PERIOD II. Out of 28 cases 20 were reduced and 8 were failures, or percentage of reduction 71 per cent.

Cases reduced classified as follows:

4 Perfect.	1 Fairly good.
12 Good.	3 Fair.

16 cases out of 20 with perfect functional result or percentage of 80 per cent.

PERIOD III. Out of 54 cases 46 were reduced and 8 were failures, or percentage of reduction 85 per cent.

Cases reduced classified as follows:

18 Perfect.	3 Fairly good.
22 Good.	3 Fair.

40 cases out of 46 with perfect functional result or percentage of 87 per cent.

PERIOD IV. Out of 89 cases 84 were reduced and 5 were failures, or percentage of reduction 94 per cent.

Cases reduced classified as follows:

41 Perfect.	5 Very good.
29 Good.	3 Fairly good.
	6 Fair.

75 cases out of 84 with perfect functional result or percentage of 89 per cent.

38 cases in which both perfect functional and anatomical result or 45 per cent. of reductions.

3 of the 5 failures were over the age limit.

COMPLICATIONS:

Applies only to post-operative complications:

In this group there were 3 cases of paralysis:

Case 9—age 5 years: Paralysis lasted several days and then cleared up.

Case 252—age 5 years: Paralysis lasted about one year, large child; manipulation hard.

Case 341—age 5 years: Paralysis lasted four months; manipulation hard.

8 cases in which there was definite limitation of motion; in several of these cases there was also some external rotation.

Several cases in which the acetabulum was noted as shallow, but these are not true complications according to our classification.

No cases of fracture, and none of permanent paralysis. No deaths from shock. One death Case 331 from bronchial pneumonia several days following a difficult manipulation.

No record of circulatory disturbance after manipulation and cast, preceded by extension weight and pulley.

ROENTGENOGRAMS:

Roentgenograms were traced in 244 of the 349 cases; many of the remaining 100 returned to patient, also roentgenograms of earlier cases in many instances are traced. In the majority of cases pictures show distortion of acetabulum, head, and neck. There are some perfect sockets with distortion of head and neck, and some perfect heads, with deformity of the socket. There are very few cases in which the anatomic structure of the acetabulum and femur are perfect. Often the radiograms of the acetabular cavity are deceiving: what appears to be a deep acetabulum is often found upon operation to be shallow, and vice versa. The distortion of pelvis and femur are very marked in the adult unreduced dislocations; and as a rule there is an accompanying change in the lower lumbar vertebrae.

SUMMARY

1. PERIOD IV was the most popular—151 cases seen during this period or 44 per cent. of the total.
2. SEX: Female 80 per cent., male 17 per cent.
3. HIPS: Bilateral and left dislocations seen most frequently.
4. AGE: 211, or 60 per cent. of cases, seen at 6 years or under. Four years most popular age. Operative difficulty increased and prognosis poorer after 6 years of age.
5. SYMPTOMS: Most popular complaint, painless limp or waddle, and late walking. Objective signs, walk, Trendelenberg and shortening.
6. DIFFERENCE IN LENGTH: Differences from ½ to 1½ inches seem most frequent. Anything over 1½ inches greatly increases difficulty and decreases prognosis.
7. FAMILY HISTORY of little importance; five cases of positive congenital history.
8. BIRTH HISTORY has little significance.

9. Operative Result: At least 85 per cent. perfect functional results can be obtained in selective cases—within age limit and shortening not over 1½ inches, preferably from ¼ to ¾ inch or less. After treatment and follow-up work is very essential. Five failures since 1915, three of which were over age limit. In our series observation on perfect hips, 1.66 years; observation on good and fair hips, 2.86 years.
10. Cast: Majority cases, 47 per cent., two casts applied: First worn 3 to 4 months, second worn 3 to 4 months; first cast, leg in 90-90 and below knee, second cast, adducted a few degrees, extended, and internally rotated, depending upon case; knee free in second cast.
11. Non-Operative Cases: Age responsible for failure to advise operation in 60 cases. In 30 cases supports were advised or applied, supports in the nature of corsets, Taylor braces, shoes, Goldthwait bands, etc.
12. Complications: Three cases of paralysis, all cleared up; one lasted a year. No fracture, circulatory disturbance, or death from shock. Eight cases with some limitation of motion.

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A NEW METHOD OF OPERATIVE REDUCTION FOR CONGENITAL LUXATION OF THE PATELLA*

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Congenital luxation of the patella has inspired a volume of medical writing, most creditable for so infrequent a lesion. Unfortunately much of the literature has been modified, or dominated, by men's ideas on that infinitely more common deformity, acquired dislocation of the patella. Such a confusion might be anticipated, for despite the evident dissimilarity of the lesions it is illogical to accept an embryological pathogenesis as the cause of the former and to attempt to ignore the latter, in which developmental defects of similar origin are so important as etiological factors.

The embryological antecedents of both lesions have engendered an interesting if unprofitable discussion relating to the development, growth, and function of the patella. Anatomists generally hold that the patella is a true sesamoid bone, originating in the tendinous end of the extensor cruris quadriceps muscle, and is accessory to the primary skeletal structure. Piersol states that the functions of the sesamoid bones are to change the direction of muscle pull and to obviate friction. In refutation of this anatomic conception, Retterer demonstrated the cartilaginous nucleus of the patella before the joint cavity had begun to form. Bernays found the hyaline cartilage nucleus before the quadriceps tendon had become differentiated. Kaczander observed that the patella did not originate in the tendon but from the prenatal eminence on the end of the femur. Lastly, Drachmann seems to completely discredit the frictional theory of development with his discovery of well formed patellae in patients with a congenital absence of the quadriceps tendon.

Before, however, divorcing the patella from the sesamoid group, and accepting it as a full fledged component of the primary skeleton, consideration must be accorded Bernays's discovery, in numerous cadavers, of a cartilaginous body, above, and connected to, the ossified patella. These bodies were located at the point of greatest attrition during the vertical excursion of the quadriceps, and he believes them to have been phylogenetic. Assuming that under the influence of tension and repeated irritation, connective tissue may undergo a metaplastic change and become hyaline

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cartilage, his conception is acceptable. Wuth, however, adheres to the specificity of hyaline tissue and considers the patella as an apophysis of the tibia.

Dunkeloh quotes Wiemuth as entertaining a theory which has the virtue, at least, of shunning all the previous discussion. He believes the patella to be a part of the quadriceps tendon, rather than a component of the knee joint. In substantiation of his idea he cites the atrophy of the tendon observed in all his cases of congenital absence of the patella, but holds that these patellae were absent as a result of the muscular atrophy, rather than the reverse. This he believes is proved by the observations of Barwell, Hartigan, Hilton, Sayre and Joachimsthal, who have observed a development of the patella after the methodic strengthening of an atrophic quadriceps. The chief difficulty in accepting Wiemuth's theory is the lack of incontrovertible evidence that the patellae were congenitally absent, for as Bessel-Hogen has found, a non-palpable patella may be demonstrated at necropsy, and it is further more generally accepted that ossification has not sufficiently advanced before the fourth or fifth years to cast a roentgen shadow.

It is not quite clear what might be accomplished by a settlement of these developmental discussions. They have secondarily lead investigators to prove that satisfactory function may be retained with the patella large, small, or entirely absent, but since the patella continues to remain an integral part of the quadriceps tendon, it is obvious and more important to observe that normal function cannot co-exist with a luxation of the tendon which carries with it the enveloped patella, irrespective of the embryologic genesis of that patella.

The writer does not believe it justifiable, despite the existence of a multiplicity of predisposing structural anomalies, to class as congenital any luxation in which the patella is domiciled between the femoral condyles at birth. Rotation of the femur, or a genu valgum, or an aplasia of the outer femoral condyle when of congenital origin undoubtedly renders perilous the functional excursion of the patella and invites an acquired deviation. In such lesions, however, the term congenital should not be extended to include more than the structural anomaly. The luxation is properly acquired and neither the developmental predisposition, the degree of displacement, nor the habitual character should modify that status.

Soliera has classified the lesions as congenital and acquired, subdividing the latter into the traumatic and the pathologic. Clinically he has spoken of the complete and the incomplete luxations and further differentiated the intermittent and permanent types. This grouping has been cited by

Dunkeloh as an improvement over that of either Reichel, Hoffa, or Bogen. Soliera has, nevertheless, failed to specify clearly under what conditions he assumes a lesion to be frankly congenital. Singer in 1856 raised a similar query and suggested the following six characteristics by which a luxation might be rightly adjudged congenital; (1) absence of deformity of the joint tuberosity; (2) perfect firmness of the joint; (3) absence of genu valgum; (4) absolute normal mobility of the knee joint; (5) freedom from difficulty while walking in a horizontal plane; (6) identical relation of the patellae on both sides.

Dunkeloh believes that these demands are excessive and agrees with Bogen that there is no reason why a number of secondary changes and functional disorders should not follow a true congenital luxation. A more modern conception would limit the essential requirements to: (1) a permanent dislocation; (2) inability to actively extend the knee; (3) unimpaired passive mobility of the knee joint; (4) absence of the patella from the intertrochlear fossa at birth.

Paletta, in 1820, reported the first case of congenital luxation, followed by Wuhzer, 1835; Lelius, 1840; and Michaelis, 1854. They were not, however, accepted as true congenital lesions by Malgaigne in his treatise published in 1855. Singer, 1856, probably recorded the first authentic case of congenital dislocation. Dunkeloh, writing in 1914, collected 103 cases, to which may be added fourteen more, a total which, it will be noted, scarcely exceeds one case per year, and seemingly includes many which should not be classed as congenital luxations. Notwithstanding the equal clinical probability of congenital luxation of the patella inward, the literature up to 1914 contains the report of only three cases of mesial luxation which are above included. With the exception of six cases of upward dislocation, the remaining lesions were all of the outward type.

Unfortunately the lack of fine distinction between the true congenital dislocations and the acquired luxations induced by a defective development has involved the operative treatment to an extent which requires a consideration of the predisposing anomalies to the intermittent lesions. Those commonly accepted are: genu valgum, genu recurvatum (Owen), inward rotation of the femur (Graser), imperfect development of the os patella, a shallow patellar fossa, aplasia of the femoral condyle, a low external supracondylar ridge (C. Davis), a lax capsule from trauma or disease (M. Davis), and over-action of the vastus externus (Murphy). It is likely that two or more of these factors share the guilt in the majority of instances, an assumption which may explain the bewildering variety of surgical procedures advanced for the relief of an apparently simple luxation. Horwitz quotes

Hubscher as enumerating thirty-five various operations, while Dreyer states that he is familiar with forty. Many are, however, only variations or combinations of certain basic procedures long in vogue.

The earliest mention of operative treatment seems to be that of Cosma in 1865, who wrote to condemn the woful expedient of his confrères. This he describes as the application of a cautery, through a skin incision, to the external femoral condyle in the hope that the resultant adhesions would have a deterrent effect upon the patellar peregrinations. Ankylosis of the knee seems to have been the usual result, thereby stimulating his enthusiasm for a lariat-like combination of a ring and a bandage with which he hoped to stabilize the patella. The modest success of this procedure perhaps inspired Thomas and Ridlon to attempt by bloodless irritation to produce hypertrophy of an under-developed femoral condyle.

More radical interferences were rapidly suggested. Davies-Colley, Mikulicz, Graser, Owen, and Hubscher sought to correct the genu valgum or the femoral rotation present in their cases by osteotomies similar to the supra-condylar operation of MacEwen. Trendelenberg chiselled the lateral condyle and inserted an ivory graft to accomplish its advancement; in the same manner Brackett utilized a graft of live bone.

Alterations of the insertion of the patellar tendon have been advocated by Casati, Roux, Dalla Vedova, Heineke, Trendelenberg, Rutherford, and MacAusland. Goldthwait split the patellar tendon and sutured the outer half under the mesial fixed portion; Hubscher and Dalla Vedova modified this by suturing the split portion elsewhere. Lucas-Championnière, Pollard, Rocher, and Murphy deepened the intertrochlear fossa by chiseling.

Bajardi, Menard, Brun, and Bardenheuer excised portions of the lax medial capsule and sutured the defect, a procedure which has been included by innumerable others as part of their technique. Le Dentu plicated the medial capsule so as to form a vertical bolster. Wullstein and Krogius fashioned bridge-like stirrups from fascia and sutured them to the outer side of the patella. Roux, Murphy, C. Davis, and Dreyer attacked the insertions of the vasti and the quadriceps tendon. Gallie fashioned a false ligament of fascia, anchoring the patella to the medial condyle of the femur. Manchet and Durand divided, after freeing, the quadriceps tendon and drew the patella and the ligament through a buttonhole in the central capsule. MacLennan, Krogius, Lanz, Hoffa, Whitlock, and Robertson have practised transferences of the gracilis, semitendinosus, semimembranosus and sartorius.

There is no desire to consider the treatment of the acquired luxations, but it is unavoidable since numerous of the preceding operations have been

described as applicable to both the congenital and the acquired varieties. A certain similarity does exist, because many procedures suggested for the prevention of an acquired intermittent luxation are valuable or indispensable in the maintenance of a reduced congenital lesion. The latter offer, however, a serious and distinguishing problem in that the reduction of a fixed luxation is not facile or spontaneous, but can be accomplished only by a structural rearrangement of the distorted joint. Some of the preceding ingenious operations, well calculated to arrest the acquired vagaries of an errant patella, thoughtlessly ignore the essential preliminary reduction, or they exchange a patellar luxation for an equally abnormal though perhaps less evident soft part distortion.

A further distinguishing factor in the fixed luxations is the different import of a co-existing genu valgum. In the habitual lesions it ranks with the normal mesial deviation of the femur in the female and may be dismissed as carrying only the stigma of an etiologic factor. With the congenital cases, however, the genu valgum is not a causative but a resultant factor, the product of the ceaseless lateral pull of the luxated quadriceps tendon, and it generally constitutes a grave deformity (Steindler, Ewald, and Bogen). As a further complication, the traction of the quadriceps often induces a rotation of the tibia outward on the femur. The operative procedure of choice is, therefore, that which accomplishes a correction of the tibial mal-alignment in its relation to the femur, re-apposes the luxated patella and tendon, assures the perpetuation of the reduction and entails a minimum of disturbance to the normal joint architecture and mechanism.

The writer's case, a male child aged 16 months, was born normally and had been considered normal until the mesial deviation of the right knee induced the parents to seek advice. The child's family history and its past medical history, as well as the general physical examination, were negative. The intellectual and physical development were unusually good. Clinical examination disclosed a normal left lower extremity with perfect function. The right thigh and calf, however, were slightly atrophic; the patellar reflex could not be elicited, or active extension of the flexed knee induced. The passive range of motion in the right knee was normal. There was flattening of the anterior surface of the knee with a palpable depression between the femoral condyles. This was accompanied by a rotation and an abduction of the tibia on the femur amounting respectively to 10 and 15 degrees. The roentgenologic examination was negative, but the diagnosis of congenital outward luxation of the patella was easily confirmed by palpation of the knee cap over the lateral border of the joint.

OPERATION

The abduction and rotation deformity of the tibia in its relation to the femur manifestly demanded the first consideration. Osteotomy offered a certain solution, but would have placed the knee joint under tremendous

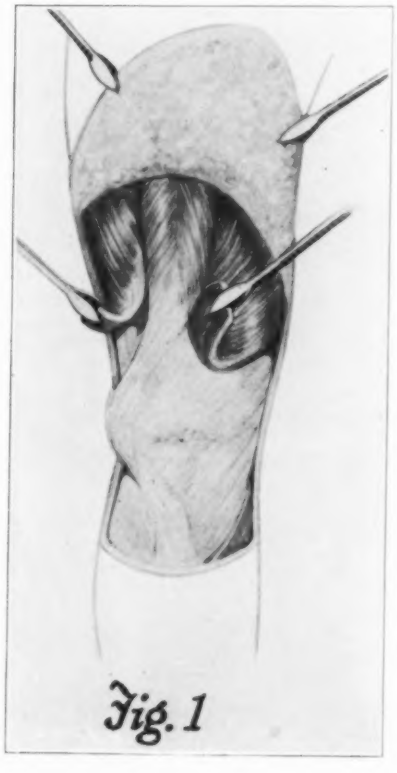

FIG. 1

The capsule of the knee joint exposed. The vasti freed and reflected upward.

permanent mechanical embarrassment, and was therefore rejected. A simpler procedure suggested itself and was entirely successful. The deformity completely yielded in four weeks to successive corrective plaster casings. The patella, of course, remaining unreduced.

Following a forty-eight hour skin preparation, and avoiding hand contact, the superior surface of the right knee joint was exposed with a U-incision, convexity downward, the outer limb of the U being carried well back over the external lateral surface and prolonged well upward. The

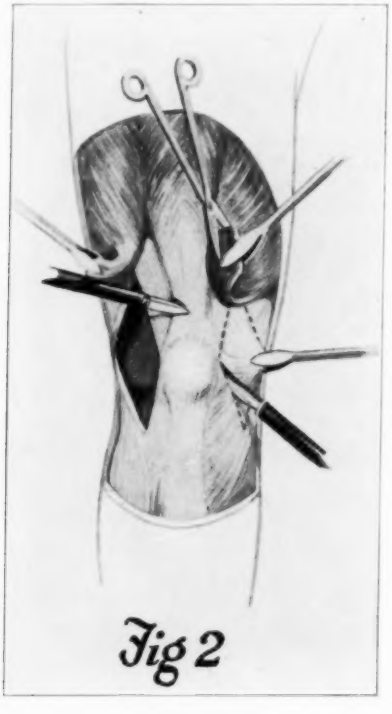

FIG. 2

The longitudinal incision in the external capsule opened to permit the reduction of the fixed luxation. Excision of the redundant mesial capsule. Partial division of the outer quadriceps fibers. Amputation of the elongated vastus externus.

exposed capsule revealed a small patella lying with its articular surface apposed to the lateral surface of the external femoral condyle, in which position it was anchored by the shortened fibers of the external capsule. A well developed quadriceps tendon accompanied the patella, dragging with it the elongated and stretched fibers of the vastus internus, while the

fibers of the vastus externus were correspondingly shortened and displaced backwards. The tendinous attachments of both vasti were primarily freed from the quadriceps tendon proper and reflected upward to receive attention later. (Fig. 1.)

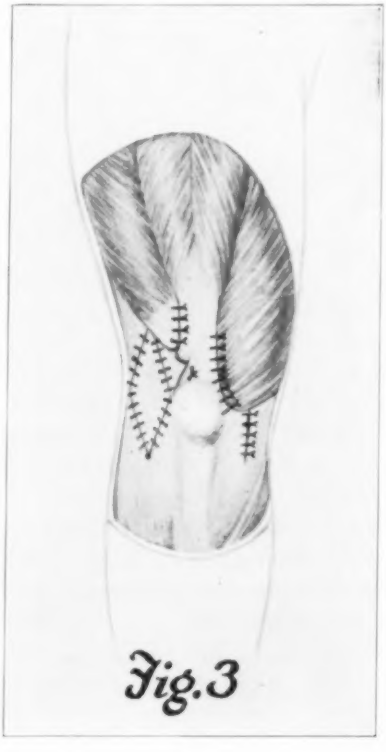

FIG. 3

The transplantation of the inner redundant capsule to the site of the external capsular defect. The reefing of the mesial capsule. The cut quadriceps fibers folded under the tendon and the vasti reapproximated.

External to the outer border of the patella and paralleling the quadriceps tendon, an incision was made extending from above downward, which, when caused to gap widely, permitted the reduction of the luxated patella and tendon (Fig. 2). This incision in the lateral capsule should be generous in length and extend through the inelastic synovia. With the rectus

femoris placed in the midline, the mesial portion of the joint capsule was now extremely redundant, and it was observed that this redundancy corresponded precisely in pattern to the diamond shaped gap present in the external capsule. This superfluous internal capsule and its underlying synovia were accordingly excised in one layer (Fig. 2) and transplanted to restore the external defect (Fig. 3). Sterile silver foil cut to conform to the external defect is of great assistance as a pattern for the excision of the mesial capsule. A continuous suture of No. 1 chromic gut was employed to approximate the graft to the capsule, care being taken to pass the sutures down to, but not through, the synovia. The resulting internal diamond shaped defect was closed with interrupted sutures of No. 2 chromic gut, a thorough reefing thus being accomplished. The joint was now, both in structure and in contour, creditably restored. Aside, however, from the shortening of the inelastic mesial capsule, nothing further assured the permanency of the restoration.

The elongated fibers of the vastus internus were next shortened by excision (Fig. 2) and the cut end sutured firmly under slight medial tension to the quadriceps and the upper border of the patella (Fig. 3).

The reflected and already shortened vastus externus was reattached, without lengthening (Fig. 3), to the quadriceps tendon at a point about one inch higher than the center of attachment of the vastus internus. This upward transference, while retaining the complete extensive power, considerably diminished the outward drag and gave to the internus, at the beginning of the patellar descent, a marked mechanical advantage.

To obviate any remaining tendency to outward excursion, the outer flaring quadriceps fibers were divided across one third of their breadth. The lower cut fringe was folded under the unsevered portion of the tendon and attached with a mattress suture of chromic gut (Fig. 3). Tucking the short cut fibers underneath has the advantage of tilting the outer edge of the patella backward, a trifling additional security which would be lost if they were sutured above and the edge tipped forward. The tourniquet applied to prevent hemorrhage into the joint was removed, the bleeding arrested, and the skin closed with a continuous fine Dermal suture. A light cast was applied with the knee flexed sufficiently to maintain the quadriceps under slight tension.

The postoperative recovery was uneventful, the sutures were removed on the fourteenth day and the cast replaced by a snug flannel bandage. Weight-bearing was allowed in three weeks and full use encouraged during the fourth week. The reduction has remained permanent and there has been almost a complete development of the normal range of active motion.

COMMENT

This early functional mobility was invited by the preservation of the strong lateral portions of the joint capsule, the undisturbed attachment of the patellar tendon, and the unviolated bony continuity. The disability and evident deformity of these congenital lesions should lead the parents to seek early advice and it seems probable that at an early age corrective plasters without anesthesia would be sufficient to correct the mal-alignment of the tibia without recourse to more radical measures.

Geometrically the transposition of a capsular segment is perfectly rational, and surgically it should be feasible to excise any portion of the anterior circumferential capsular arc and transpose it to the opposite side of the knee with a mathematically equivalent variation in the position of the patella. The capsular integrity, however, restored by the free transplantation of capsular and synovial tissue *en masse* is admittedly experimental and the ultimate success is dependent upon the preservation of its viability. The work of Gallie and Le Mesurier with the free transplantation of tendons and fascia possesses the same element of doubt, but has been eminently successful with tissues which offered a far poorer opportunity for vascularization.

Thirty-five years ago Pollard wrote condemning the fallacy of attempting open reduction of a fixed luxation without dividing the inelastic synovia. His observation was undoubtedly correct and discredits the extra synovial procedures of Bardenheuer, Duclaux and Chenier, and McLaren, calculated to preserve partially the normal anatomy.

Roux, Krogius, Wullstein, Murphy, Parker, and Marwedel, disregarding the tissue deficiency, have attempted suture of the cut edges following the capsular division incident to an open reduction. Manchet and Durand sought to preserve the capsule by an ingenious method which divided the quadriceps tendon and brought the patella over the capsule through a buttonhole in the midline. Bastianelli suggested the use of a pedunculated flap of fat to close the synovial defect. With these exceptions the loss of the capsular continuity has been coldly ignored. This oversight is furthermore particularly unjustified when it is recalled that synovial tissue has not been proven to possess the inherent ability to regenerate (Editors: Progress of Orthopædic Surgery).

The observations of Roux, Murphy, Dreyer, and C. Davis have inspired the method here selected of accomplishing a reconstruction of the patellar mechanism. It seemed illogical in the presence of so marked an intrinsic muscle distortion to seek aid from any of the varied extrinsic

transferences, such as those of the gracilis, the semitendinosus, the sartorius, or even the patellar tendon itself. The external femoral condyle was not hopelessly under-developed and the intertrochlear fossa might properly be expected to deepen as it became accustomed to acting as host to the apposed patella.

C. Davis thinks that it is highly unlikely that the habitual luxations occur at the end of the downward excursion of the patella. A more logical assumption is that a distorted or over-acting vastus externus directs the descent on or to the outside of a poorly developed external supra-condylar ridge and that the patella is actually guided outward into luxation. A trivial force then exerted inward at the beginning of the functional excursion will have a far greater stabilizing influence than seemingly much more positive forces applied at the termination.

SUMMARY

It is desired to emphasize again the statement that the acquired and congenital patellar luxations have not been carefully differentiated and that similar operative procedures are manifestly illogical of application to dissimilar surgical problems.

The acquired luxations invite the solution of a problem in faulty functional joint mechanics. In distinction, the congenital lesions demand the reduction of a fixed dislocation and an anatomic restoration before the functional mechanism can be considered.

The above procedure accomplished the correction of the genu valgum and the tibial rotation, without a violation of the bony continuity, by the preliminary application of successive corrective plaster casts.

The unavoidable defect resulting from the open reduction of the fixed patellar luxation was completely repaired by the free transplantation of redundant capsular and synovial tissue.

Finally, the permanency of the reduction was assured by the reefing of the mesial capsule and a reconstruction of the lines of torsion of the extensor mechanism with which the patella is integral.

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THE ASTRAGALUS*

A Case of Dislocation, Excision, and Replacement. An Attempt to Demonstrate the Circulation in this Bone

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Our interest in this subject had its origin in a case operated on at the Hospital for the Ruptured and Crippled, New York City, on September 20, 1920, in which the bone was dislocated, removed entirely, replaced in normal position,—and has continued to function normally to date.

History. On September 16, 1920, a man weighing one hundred ninety pounds fell forty-five feet, landing mainly on the left foot. He was taken to the hospital, where an anesthetic was given and an unsuccessful attempt at reduction was made. On September 19, three days later, it was decided to amputate the foot. The patient refused and was transferred to the Hospital for the Ruptured and Crippled.

Examination. On examination the left foot and leg were markedly swollen and discolored to the knee. The foot was in a position of equinovarus and there was a large tumor on the outer side opposite the ankle-joint. Roentgenograms were taken (see Figs. 1 and 2) which showed (Fig. 1) a complete lateral dislocation of the astragalus from the mortise of the ankle-joint. The external malleolus was fractured at its base and lay parallel with the lower end of the fibula. The foot was displaced forward about three-quarters of an inch and the distance between the os calcis and articular surface of the tibia was markedly diminished.

Operation. It was decided to operate. A curved incision four inches long, parallel to the peroneal tendons, was made on the outer side of the foot. The astragalus was exposed and found to be completely torn loose from all its attachments with the exception of a small band on the inferolateral border.

* Presented at the Annual Meeting of the American Orthopedic Association, May, 1924.

An ineffectual attempt was made to replace the astragalus. It was necessary to divide the peroneal tendons and completely remove the astragalus before this could be done. The foot was then extremely inverted and the astragalus was replaced in its normal relationship with the

FIG. 1

Complete lateral dislocation of the astragalus from the mortise of the ankle joint.

tibia, and so held by an assistant. The foot was then forced back into its normal position (Figs. 3 and 4). It is worth mentioning that considerable force was necessary in order to accomplish this, on account of the condition of the tendons and tissues about the ankle-joint. The external malleolus was then forced down and sutured in position. The peroneal tendons were then sutured and the wound closed. A plaster cast

was applied and the patient returned to the ward, where his foot was maintained in an elevated position.

POSTOPERATIVE. The wound healed by first intention. Roentgenograms were taken after operation (Fig. 3 and 4), which showed the as-

FIG. 2

Displacement of the foot and astragalus forward.

tragalus and fibula properly reduced and in normal position. X-ray examinations have been made at intervals since the time of operation and the astragalus has been found to be normal in position and architecture.

The patient now walks without a limp, although flexion and extension are slightly limited and eversion and inversion are markedly limited.

FIGS 3 AND 4

Astragalus after replacement.

FIG. 5

(Photograph Fig. 5.) (Note this shows the man standing on toes and in normal standing position.) The patient has no pain and goes about his work every day as a boiler inspector.

Many severe dislocations of the astragalus have been reported. In

FIG. 6

Series A. Anterior-posterior view, after injection with bismuth dichloride.

FIG. 7

Series A. Lateral view, after injection with bismuth dichloride.

1883 Basil Norris, Surgeon, U. S. A., read a paper before the American Surgical Association. In preparation for his paper, Norris made an exhaustive study of the literature and corresponded with or consulted many of the distinguished surgeons of his day. Among these were Sayre, Gross, George W. Norris, N. S. Lincoln, Ashford, Vollum, Post, Ganley, and

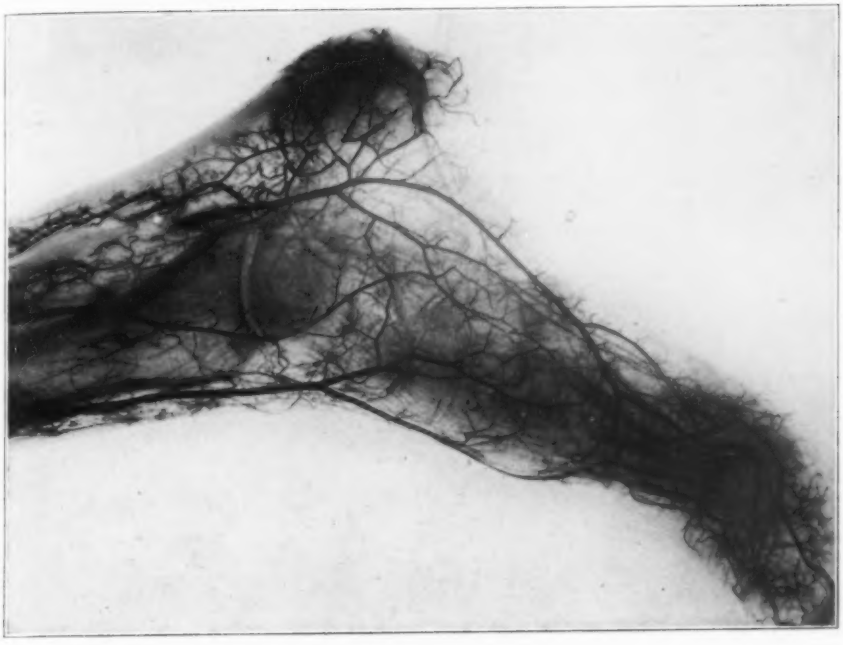

FIG. 9
Series A. Lateral view.

FIG. 8
Series A. Anterior-posterior view.

Agnew. In the main, Norris's report deals with the diagnosis and methods of reduction in dislocation of the astragalus, but besides this he reports a number of cases (one hundred fifty) where the astragalus had been removed for this injury. In making this report Norris remarks that the great master, Nélaton, believed that reduction of a dislocated astragalus should not be done because the circulation of the astragalus is so impaired in this injury that the vitality of the bone is threatened.

FIG. 10

Series A. After all tissues were removed from the bone.

It has been stated by Gross that this bone should be removed in *all* cases of severe dislocation. No reason for this statement was given.

In considering injuries of the astragalus it may be of interest to note that no mention of the blood supply of this bone is made by Cunningham, Piersol, Gray, Gerrish, and many other anatomists.

Many workers have investigated the circulation of the long bones and many investigators have used the injection method for these. Among

FIG. 11

Series B. After weak injection of fifty per cent solution of sodium iodide.

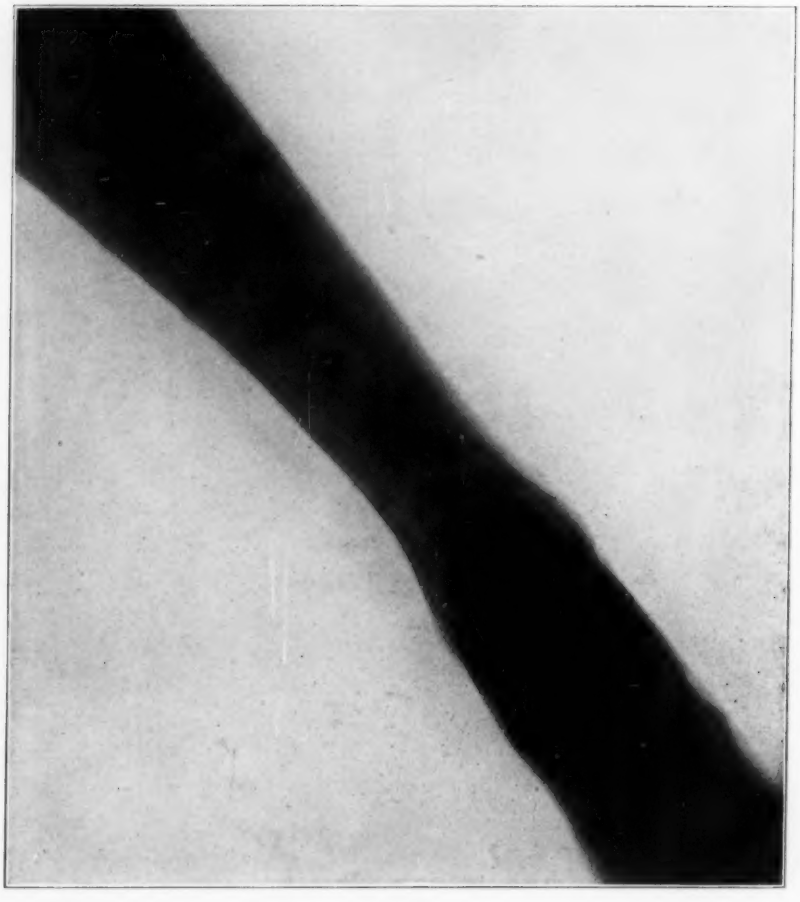

FIG. 12

Series B. After injection of fifty per cent solution of sodium iodide, under force.

these the work of Lexer is a classic. In his paper a print was shown of the astragalus, but the circulation was not described.

MATERIAL

In the investigations made at the Cornell Laboratory of Anatomy we have injected five legs,—three with bismuth dichlorid, one with 50 per cent. sodium iodid and one with 25 per cent. collargol.

FIG. 13

Series B. After injection of fifty per cent solution sodium iodid, under force.

TECHNIQUE—SERIES A. Three legs were used for injections with bismuth dichlorid. The first, fresh specimen, was the product of an amputation for tubercular knee performed the day before. This was embalmed and all fluid was drained from it before endeavoring to inject the posterior tibial artery. All other large vessels were ligated. First, a

FIG. 14

Series B. Specimen injected with twenty-five per cent solution of collargol. View taken after removal of most of the tissues.

very weak solution of this was injected and then a much stronger suspension. This was injected slowly with gradually increasing force. The force could not be accurately estimated in pounds, but was applied to the degree where the artery distal to the nozzle of the syringe began to balloon

FIG. 15

Series B. Showing collargol injection.

out. The piston was tied down at this point and left over night. The same technique was used in the other two cases of this series, with the exception that the legs were drained but not embalmed. We noted, after several hours, that the fluid began to come back through the sawed-off end of the tibia.

SERIES B AND C. An attempt was made to remove the blood from two other specimens by suction on the popliteal veins, maintained for

FIG. 16

Series C. After collargol injection.

FIG. 17

Series C. After collargol injection.

twelve hours while the foot was held in an elevated position. One of these specimens was injected with a 50 per cent. solution of sodium iodid. (Series B.) The other specimen was injected with a 25 per cent. solution

FIG. 18

Astragalus.

FIG. 19

Normal astragalus.

of collargol. (Series C.) In this latter connection, when dissecting down upon this bone and trying to remove the fibrous tissues from it, we noted that there were numerous small blood vessels in the bone. The black collargol showed this distinctly macroscopically. The figures in Series A, B, and C may be compared with a normal bone, Fig. 19.

SUMMARY

Function may be hoped for after removal of the astragalus with its cartilage intact and replacement of this bone.

We believe that in all severe dislocations of the astragalus the blood supply of the bone is interrupted,—perhaps temporarily destroyed.

There is no main nutrient artery to this bone. It is supplied by numerous small blood vessels.

We are of the opinion that the vessels supplying this bone cannot be stretched to the degree necessary for dislocation without rupture. This confirms the statements made by Nélaton.

We believe that in severe dislocations of the astragalus this bone may be replaced in normal position and a good functionating foot may be hoped for.

I wish to express my gratitude to Dr. C. R. Stockard and his Staff, of the Department of Anatomy, Cornell University Medical School, for their suggestions and help in the preparation of this paper.

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A METHOD OF PASSING BONE SUTURES AT A DEPTH, WITH OBSERVATIONS ON EXTENSOR CONTRACTURE OF THE FIFTH METATARSAL BONE*

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Under conditions which vary widely, it is frequently desirable to place sutures through bone in the depths of wounds. If the sutures are to be of wire, there is no great difficulty involved; the drill may have a perforation near its end through which the wire may easily be drawn. At the present time, however, wire is used for this purpose relatively seldom and the absorbable sutures are too thick and too pliable to be thus managed. For the most part I prefer to use kangaroo tendon for bone sutures, and especially when tendons are to be attached to bone. There are, moreover, certain situations in which it is desirable to pass sutures which are quite thick through bone which is at a considerable depth from the surface: I shall later cite arthrodesis of the shoulder as such an example. Under these circumstances I have often been embarrassed by the difficulty of passing the deep part of the suture and I have witnessed the struggles of others engaged in the same task. The solution has usually been found in drilling a canal of such ample caliber that the kangaroo tendon could be passed through after the drill was withdrawn. The finding of the deep end of the suture was then frequently difficult and time consuming; sometimes the entrance of the suture into the drill canal was far from easy. In case tendon is to be attached to bone, it is often not possible to drill a wide canal lest it break through; if one particular method be used, moreover, the suture must be passed from the inside of a depression which has been made in the bone to its surface. It is unnecessary to multiply the instances, since they will suggest themselves to all who do this kind of work.

The method which is here presented is so simple that I hesitate to dignify it by this report. At the same time, it has proved to be so useful and economical of time and effort in placing deep sutures in bone that I am, nevertheless, moved to do so. The essentials required are bone drills of different length and thickness which are suitable to the purpose in question and which are provided with a perforation near the tip, which need not be

* Presented at the Annual Meeting of the American Orthopedic Association, May, 1924.

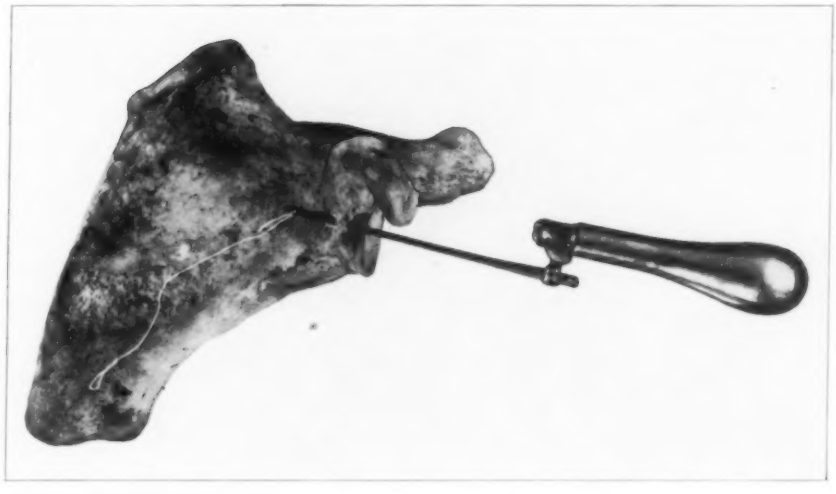

FIG. 1

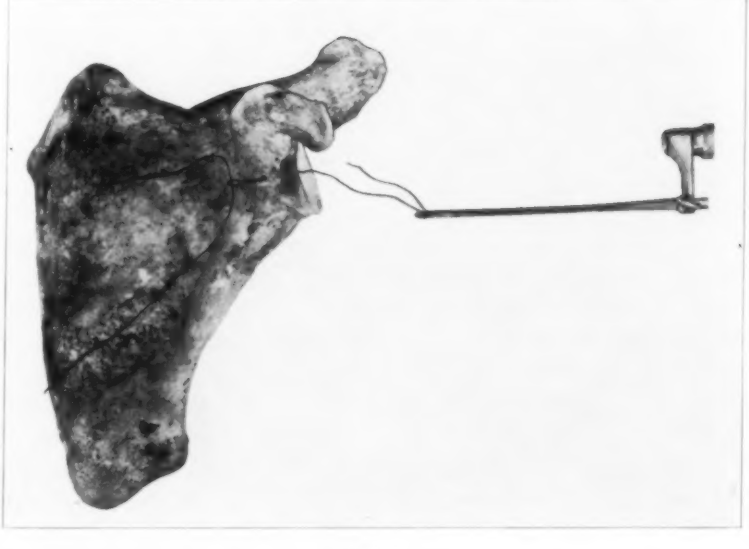

FIG. 2

more than 0.75 mm. in diameter. Wire loops should be at hand made from bright iron wire such as may be purchased on spools in all hardware stores. Number 34 has been found to be a convenient size for all purposes. Pieces of wire are cut into lengths of six inches. At one end of each piece a loop is made in such a way that the limbs of the loop are twisted around *each other* and the short end is cut very close to the loop. If the one limb be twisted around *the other* or if the end be left long, the end is apt to be caught at the opening in the bone and its passage interfered with. A num-

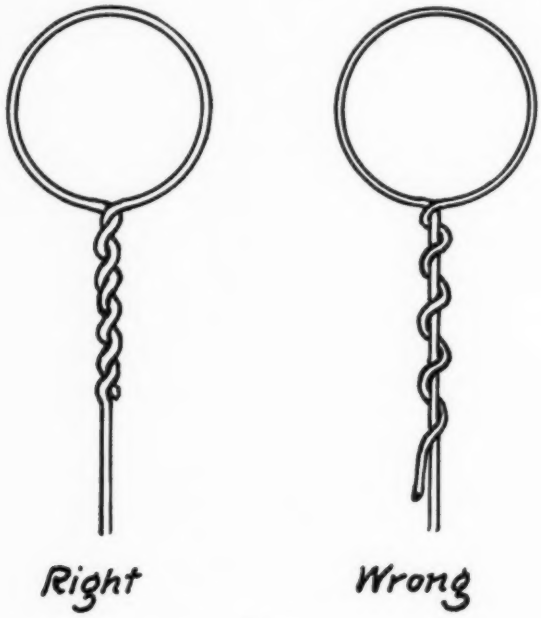

FIG. 3

ber of the loops, which are easily made by the nurses, are always kept on hand. A refinement which is worth while consists in soldering the twist with a soldering paste called "Tinol." This is done over a flame or even a lighted match. The loops may be used a number of times. By means of such a wire loop a bone suture may be drawn from any depth in which it is possible to see the perforation in the drill point. The wire is easily inserted into the perforation if only the drill and the wire are bright and easily seen. The wire having been inserted into the perforation of the drill, the drill is withdrawn, bringing the wire with it. The kangaroo or other suture is now

engaged in the loop and the wire is entirely withdrawn, bringing the suture with it.

In doing arthrodesis of the shoulder it is desirable to pass a suture from the depth of the glenoid fossa through the neck of the scapula, emerging on the anterior aspect of the scapula below the base of the coracoid process. When the suture end, so placed, is tied with another which has been passed through the head of the humerus, the humerus is easily held firmly in contact with the glenoid fossa. By means of a drill with a shank four inches long a suture may be passed thus very easily. I had found this very difficult to accomplish before using the wire loop.

When a tendon is to be attached to the surface of a bone, this is conveniently done by suturing it into a pit which has been made on the surface.

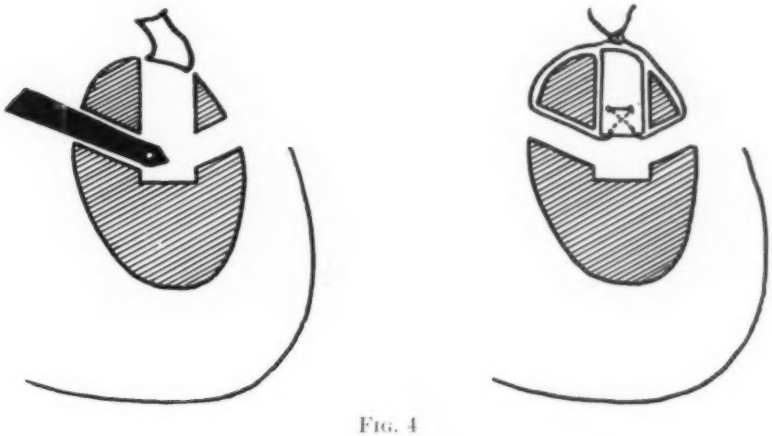

FIG. 4

The periosteum having been cleared from the location which has been chosen, a hole is drilled into the cortex and this is enlarged to the desired size by means of a reamer. From the sides of the pit thus made holes are drilled obliquely by means of a slender perforated drill. The wire is inserted into the perforation of the drill as it appears in the bottom of the pit, and the suture ends are pulled through by means of the loop. When they are tied over the bone the end of the tendon is thus held securely in contact with the bottom of the pit.

By means of the method described, sutures may be passed from bone to bone at any depth and, it is believed, with greater facility than has been the case with other methods. At the same time there are situations in which difficulty is offered not so much by the depth of the wound as by its

narrowness and therefore by the impossibility of drilling into the pit from its sides. Such a situation may be found when it is attempted to insert the ends of the extensor tendons into the heads of the metatarsals, a procedure which has at different times been proposed for the treatment of extensor contractures of the toes. In this connection it may be worth while to record an experience with cases of such contracture of the fifth toe, in particular.

FIG. 5

EXTENSOR CONTRACTURE OF THE FIFTH TOE

Extensor contracture of the fifth toe is a condition found not infrequently as the cause of considerable suffering and disability. By this designation is meant a contracture in which the proximal phalanx is extended (dorsal-flexed) upon the metatarsal, the proximal interphalangeal joint being flexed (plantar). The condition is, therefore, essentially similar to that so often found in the second toe and which is spoken of as "hammer-toe." Just as is the case with hammer-toe, this condition is often seen in minor grades which cause little or no inconvenience; on the other hand it is by no means unusual to find the contracture at the metatarsophalangeal joint of such degree that the proximal phalanx is held vertical or nearly so. The proximal interphalangeal joint is thus subjected to pressure and friction with resulting callosity, which is often extremely painful while the shoe is

being worn. I have most often seen this condition in girls or women and almost always it was present in both feet. In nearly every instance which I can now recall the remaining toes were somewhat abnormal in the same sense, although I do not here refer to cases which would justify the designation of "claw foot." Similarly are paralytic feet excluded from this consideration. (Fig. 5.)

If advice for the treatment of this condition be sought in the literature, the recommendation will be found either to operate as for hammer-toe, by excision and synostosis at the proximal interphalangeal joint together with tenotomy of the extensor tendon, or, more often, to amputate at the metatarsophalangeal joint. The excision at the fifth toe has not been

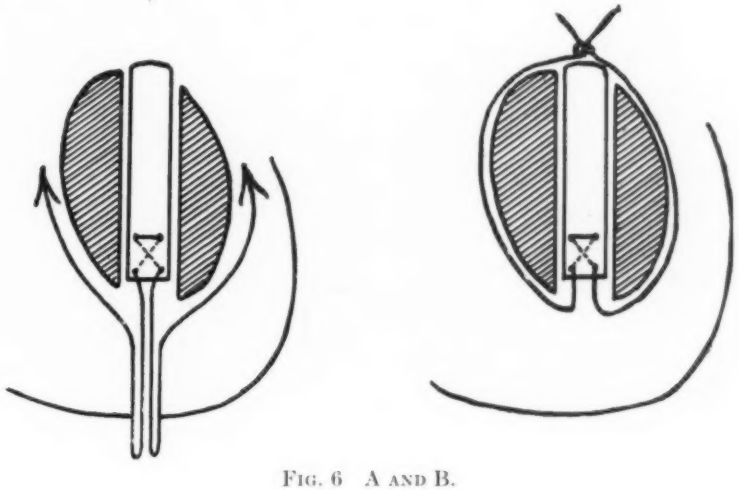

FIG. 6 A AND B.

found satisfactory, as is the case, almost always, at the second. Amputation, on the other hand, constitutes a mutilation and disfigurement which, though much less objectionable in the case of the fifth toe than in that of the second, is, nevertheless, undesirable: the more so since we are most often dealing with women. Tenotomy or even the transplantation of the extensor tendon to the head of the metatarsal, with or without the excision, has frequently been followed by recurrence of the deformity.

For these reasons the following operation has been done a number of times and thus far without cause for dissatisfaction. A dorsal incision is made in the axis of the toe, from a point one-half inch proximal to the head of the metatarsal to the proximal end of the middle phalanx. The

extensor tendon is cut at the interphalangeal joint and the tendon is turned up to the upper end of the incision. The end of the tendon is denuded by scraping with the knife. A kangaroo tendon suture is inserted into the end of the tendon and the ends left long. The proximal phalanx is now excised *in toto*, and in doing this it will be found easier to begin at its proximal end. A hole is now bored through the metatarsal head from the dorsum and until the drill can be felt through the sole. By means of a three-sixteenths inch reamer this is made into a canal. Both ends of the kangaroo suture are threaded into the eye of a straight needle, which is then thrust through the bone canal and made to emerge in the sole of the foot. One end of the kangaroo suture being withdrawn from the needle, the needle is made to re-enter the opening in the skin through which it came, but in such a way as to appear in the dorsal wound mesial to the head of the metatarsal bone and very close to it. The second end is now threaded into a straight needle and passed back through the same skin opening, but to the lateral side of the metatarsal head. When these ends are tied, the tendon will be held firmly within the bony canal. (Fig. 6.) The skin wound is then closed.

In several instances the tendon implantation, together with the excision of the dorsal part of the joint capsule, was done without the removal of the phalanx. In two cases recurrence of the deformity was noted and the excision of the phalanx was subsequently made necessary. The recurrence of the deformity after the removal of the insertion of the extensor tendon from the phalanx to the metatarsal head and the excision of the dorsal part of the joint capsule was difficult to explain. At the time of re-operation it seemed apparent that regeneration, or at least reformation, of the tendon had taken place to the point of its original insertion. That this may be expected to occur quite uniformly has been explained by Batson and Zinninger, of Cincinnati, in the course of experimental work as yet unpublished, and also in 1911 by Sever (Boston Med. and Surg. Journ., p. 748). It seems apparent that the transmission of functional stresses from the proximal end of the tendon, which has been transplanted, takes place through the medium of the cicatricial tissue, which again connects it with its original point of insertion, and that the effect of this is a sufficient differentiation of tissue to make its original function possible of reëstablishment. This really constitutes a confirmation of Wolff's Law, as applied to soft tissues. In any case, it would seem to establish the fact that simple transplantation of the extensor tendon to the metatarsal head may not be looked to as a reliable means of disposing of an extensor contracture, without some provision for avoiding this reëstablishment of tissue continuity.

The removal of the phalanx has seemed the simplest way of accomplishing this. It is not improbable, however, that a better way will be found.

DISCUSSION.

Dr. Leo Mayer, New York City: I have often experienced difficulty in getting sutures into bone and I shall in the future take advantage of the method which Dr. Freiberg uses. In a large number of cases it is very simple to run the kangaroo tendon through. In ordinary bone grafting it is quite easy to pass the kangaroo tendon through, but in case of an arthroplasty of the shoulder I can see the advantage of the method described.

When it comes to operations on the little toe I must admit that the results obtained by amputation are so gratifying that I have hesitated to do anything else. I find the disfigurement is so slight that even lady patients take to it. If the method is used of excising the phalanx and running the sutures through the metatarsal bone, I am wondering why Dr. Freiberg should consider it wrong to tie the sutures on the sole of the foot. In doing a Jones operation on the metatarsal bone I have always tied the sutures on the sole of the foot, inserting a piece of gauze between the sutures. There have been no unpleasant results. Of course it is possible to pass them back through the metatarsal bone, but it seems to be an unnecessary bit of technique.

Dr. J. P. Lord, Omaha, Nebraska: I have had considerable experience with excision of the head of the fifth metatarsal for retraction or dorsiflexion of the little toe. While at Fort Riley I found a number of cases of what I called "external bunion" involving the fifth metatarsophalangeal joint. In extreme cases I secured relaxation and changed the position by excising the head of the bone, and by making an incision on the mesial side downward between the fifth and fourth toes, to make a V of the soft tissues, pointing backward on the flexor surface. I then extended this incision backward from the point of the V onto the sole of the foot. Thus this V-shaped tongue is carried as far backward as is necessary and secured by sutures to hold the toe down or in a straight and corrected position. I thus held the little toe down by the V of soft tissue. I have found this method very successful in my hands.

ESTIMATING END RESULTS FOLLOWING INJURY*

BY JOHN J. MOORHEAD, M.D., F.A.C.S., NEW YORK

Every branch of science has an established basis of arbitrary standards which have been mutually agreed upon to determine scientific observations and results.

The value of the American penny, for example, or the American dollar, is the arbitrary value fixed by definite authority. Likewise the passage of time is determined by arbitrary rulings imposed by authorities selected for the definite object of standardizing such commonplace units as minutes and hours.

Our government and many scientific organizations maintain a so-called Bureau of Standards which is an authoritative source of information supplying data of scientific accuracy.

The value of such standards is indisputable and no scientific investigation worthy the name would be possible unless all investigators made use of these agreed upon basic factors.

In our profession we have an arbitrary standard for such common manifestations as pulse and respiration rate, for temperature range, for height and weight gain. Many of these standards are based on the rule of averages and are determined by observation of thousands of cases by thousands of observers.

In the examination of the blood we have certain standards based very largely on the rule of averages; every laboratory subscribes to the essential accuracy of these standards so that the report of a blood examination made in California is in terms of a similar examination made in Maine. We speak the same scientific language all over our country in matters of this sort, but as concerns many other equally important matters our language is not in the least scientific, if, indeed, it is at all intelligible.

There has always been a desire on the part of the profession to obtain some definite basis for estimating end results following pathologic processes of a medical, and particularly of a surgical, character.

This desire is almost a necessity as related to the outcome following injury, for the traumapathies are of all forms of pathology the most likely

* From the Department of Traumatic Surgery, New York Post Graduate Medical School and Hospital. Read before the Section of Surgery, Rochester Academy of Medicine, November 26, 1924.

to bestow measurable permanent defects. Thus far we have rated our end results in terms of words, using such expressions as "good result," "fair result," "bad result," "fatal result." It is obvious that the use of such words depends almost entirely upon the personal or verbal equation of the observer, and takes little or no account of the various elements that collectively determine the end result. Two observers, for example, each equally competent, may rate the same fractured ankle in two categories, one calling the result "good," the other calling the result "fair." This divergence of opinion is because different standards are employed, or because false standards are employed, as in reality both observers should be in approximate agreement as to the outcome based on factors which could previously be agreed upon mutually.

If we attend a horse show we know that the judges rate the exhibited classes based upon certain pre-arranged standards, such as action, looks, deportment. They allot a certain percentage for each of these component elements, then compare their respective ratings, and award the blue, the red, or the yellow ribbon accordingly. A like process is employed in rating farm products at a country fair, or in disposing of a second-hand automobile; but when it comes to rating human beings, we immediately revert to terms so indefinite and inaccurate that we cannot agree among ourselves, the best judges, and of course our own controversies are then used to our own detriment and often to our own chagrin.

In effect our own failure to agree upon acceptable or accepted standards negatives our own analysis and permits a spurious analysis to have equal weight and standing.

On cursory survey of the problem it would appear that relatively definite standards for estimation would be impossible and that there are in reality no elements capable of being reliably grouped to permit the desired assay. The contrary, however, obtains, and in reality it is by no means difficult to arrive at an acceptable set of standards if we will approach the problem in an effort to achieve approximate agreement. As stated in a prior publication,[1] we have in our service adopted the plan of estimating our end results by agreeing that *function* is the essential end in view, and that *union* and *contour* are in reality often subsidiary end effects. By *function*, we mean the capacity to perform. By *union*, we mean the state of repair. By *contour*, we mean the external appearance. It is conceded that these three elements are chosen arbitrarily and are often inter-related and may even be inseparable. Reflection, however, will indicate that in many instances function may be excellent despite

[1] Jour. Am. Med. Assn., Sept. 2, 1922, Vol. 79, pp. 824-825.

obvious defects as to union or contour. Witness the almost perfect function of the shoulder following mal-union or non-union of a fractured clavicle. Colles' fracture is another instance in which deformity does not necessarily mean disability. In any estimate, it will be conceded that actions speak louder than looks, and for that reason *function* is rated higher than any other factor. If we agree that *function* + *union* + *contour* = end result, it then becomes necessary to allot to each element a certain percentage value, if we assume that the sum of these three elements equals 100 per cent. Accordingly, we arbitrarily assert that perfect *function* is entitled to 60 per cent, perfect *union* is entitled to 20 per cent, and perfect *contour* is entitled to 20 per cent. As an example of the working out of this percentage basis, take a Pott's fracture of the ankle. If the function is perfect, we allot 60, but if there is joint stiffness or joint pain, we seek to estimate how much this dysfunction detracts from the normal. If the joint is impaired 50, or 25, or 10 per cent we deduct that amount from 60. Let us assume a 25 per cent reduction; 25 per cent of 60 is 15, and 15 from 60 is 45, hence we allot 45 per cent for function. Now perfect union of the ankle counts 20, but in the case under discussion the alignment is not perfect, the callus is rough and somewhat adherent and is, we will say, 25 per cent lacking in perfection. Now 25 per cent of 20 is 5, and 5 from 20 is 15, so we allot 15 for union. Contour if perfect would count 20, but in this case there is some swelling and eversion amounting to 20 per cent. Now 20 per cent of 20 is 4, and 4 from 20 is 16, so we allot 16 for contour. Hence, our rating for this ankle is F 45, U 15, C 16, so that the addition of these three gives a total of 76 per cent, which expresses our end result.

If desired, we can go a step further and say that 76 from 100 = 24 and say that our defect amounts to 24 per cent.

We can come very close to agreement by a method based on these components; indeed, we are much more likely to thus agree than if we use indeterminate words like good, fair, poor, or bad. For comparative purposes we call the result good if our percentage ranges between 70-100; fair ranges between 50-70; poor ranges from 30-50; and bad ranges from 10-30. The method is of course arbitrary, but it has the merit of predetermining the value of a certain three components of admitted consequence.

To determine the values we must always bear in mind the main function of the part affected. We know, for example, that the lower extremities are chiefly concerned with locomotion and weight bearing; that the upper extremities are chiefly concerned with grasp and push and

pull power. We further realize that an end result is determined by the physiologic return to normal in terms of function, plus the anatomic restoration in terms of union and contour. The sex, age, and occupation of the patient are elements that play an important part in our estimate. A stiff wrist in a laborer may be detrimental, but in a pianist, ruinous. A facial scar in a man may be of little consequence, but in a woman it may be an absolute disability. A clerk with a shortening and limp may suffer no occupational handicap; but a laborer may thereby be placed in the crippled class.

Another advantage of this numerical classification over the verbal classification is the ease by which our pre-treatment may be compared with our post-treatment results.

This applies especially to old cases. Take a recent example in our service. Five days after injury a 12 year old boy entered the hospital with an epiphyseal separation of the lower end of the femur plus a fracture of the inner part of the adjacent shaft. There was marked bony and soft parts deformity, and the limb could justly be rated as almost totally disabled. F could be rated as 10 (instead of 60), U as 5 (instead of 20), C as 5 (instead of 20). So that here we start with a 20 per cent result, assuming that the limb was worth anything at all in its present state. After our first treatment we are able to rate F as 40, U as 12 and C as 12 = 64 per cent. Then as further improvement takes place, we change our ratings until at the end of six weeks we will get to F 50, U 15 and C 15 = 80 per cent.

Thus we started with a 20 per cent result and ended with an 80 per cent result, thus showing by the same standards throughout a gain of substantial proportions.

The method has wide applications and provides us with a definite scale of percentage measurements that we can use from the start to the finish of any case.

For purposes of recording in private or hospital cases, we submit that figures thus arrived at are more exact than words, however verbally elegant these last may sound. For compensation or other medico-legal purposes, a method of this sort makes a strong appeal, inasmuch as the laity are accustomed to deal with figures in rating the value of any product. We all appreciate the difficulty of properly conveying a technical meaning to arbitrators, commissioners or judges who have little or no medical knowledge. We should not blame these laymen for our difficulties until we have some standards of our own which have been accepted by the best elements of our own profession. It is a trite rebuke, often

merited, that "Doctors disagree," and when we disagree among ourselves, how can we expect agreement among others less qualified than ourselves?

We should adopt some standard, arrive at some common denominators, to measure in figures what we now try to measure in words. The task is not difficult if a common purpose is to be achieved, notably as we are all agreed that a remedy for present confusion is demanded.

This plan is submitted as it represents a tried procedure of established worth in estimating our own results in hundreds of cases. It is presented to you in the hope that your experience with it will cause you to accept it as presented, or that modifications may be adopted if it proves faulty.

The point is that we should unite on *some* standard so that instead of the present fog of disagreement we may attain the clear light of substantial agreement.

INTERNAL DERANGEMENT OF THE KNEE-JOINT

BY W. ROWLEY BRISTOW, F.R.C.S., LONDON

FOLLOWED BY THE GENERAL DISCUSSION AT THE ANNUAL MEETING OF THE BRITISH ORTHOPÆDIC ASSOCIATION, MAY, 1924

In opening the discussion on Internal Derangement of the Knee, it has seemed imperative to go over a good deal of ground, and to include much that in this Association must be regarded as common knowledge.

The views presented in the following paper will, I hope, form a basis for discussion on several important points, particularly with regard (1) to the anatomy of the internal lateral ligament; (2) to the mechanism of production of injuries to the semilunar cartilages; (3) to the differential diagnosis; and (4) to the details of treatment.

Further, an effort has been made to trace as far as possible the after-history in a personal series of cases, both non-operative and operative. It is thought that the small series of one observer will in this instance be preferable to a collected series. The difficulty in following up any series will be apparent to anyone who undertakes this task, and the writer is fully aware of his own shortcomings in this respect. Faulty note-taking, insufficient records, and the impossibility of tracing the patients some years afterwards, have curtailed the series here presented. The large number of patients who came under observation during the war in the military orthopædic hospitals, and later in the early days of the pensions hospitals, yield little in the way of end results. The difficulty of tracing these patients has proved, in the majority of instances, insurmountable.

DEFINITION AND HISTORICAL

Internal derangement of the knee-joint—a descriptive term employed by William Hey, of Leeds, in 1784—covers a wide field. No good purpose will be served in tracing the gradual evolution which has taken place both in diagnosis and treatment since that time, nor will a detailed discussion of the successes or failures of the "bone-setters" and other unqualified practitioners be followed out. These and like matters are fully detailed elsewhere, and the literature on the subject of internal derangement is already of huge proportions.

SOME POINTS IN ANATOMY AND PHYSIOLOGY AND THEIR PATHOLOGIC SIGNIFICANCE

In order to understand the mechanism of production of the injuries of the knee-joint, complete familiarity with the anatomy of this articulation is essential. Familiarity with the ordinary description of the anatomical text-books must be taken for granted, but to certain structures attention will be drawn.

The Muscles.—In the majority of joints, and particularly in the knee joint, it is necessary to appreciate the paramount importance of the musculature in controlling joint function. The fact that in the knee there are strong and important ligaments whose position and exact attachments are insisted on, may lead us astray in our conception of the physiology of the joint.

It is possible only to appreciate the mechanism of joint injuries where we appreciate the rôle the muscles play in normal joint function. The muscle must be regarded as the first line of defence against strain. The ligament is the second line, and with prolonged action of the damaging force, or too strong action of that force, the second line gives way. The appreciation of the paramount importance of the quadriceps extensor is the key to a proper understanding of the knee-joint.

It is not so much bulk of muscle, but rather quality of muscle, and muscle tone, which are the deciding factors. A wasted quadriceps with loss of tone will not permit of proper joint function, and will allow of strain or damage to synovial membrane and injury to the joint on the slightest provocation. Moreover, in the case of a joint recovering from trauma, whether it be accidental trauma or the trauma which of necessity accompanies an exploratory operation, it is once again the condition of the muscle which will be the deciding factor which determines both the rapidity and the completeness of recovery.

The vastus internus element of the quadriceps is the most important structure to be considered in this connection. This muscle is the first to atrophy—immediately losing tone, and later bulk.

The importance of the ligaments has been over-emphasised, and there is a danger that we may lose sight of the paramount importance of the musculature, when we lay stress on the crucials and the lateral ligaments. I do not mean to suggest that a ruptured crucial ligament can be compensated for by a good quadriceps, or that a rupture of the internal lateral ligament is of no moment, but there has been a tendency to set such store on these structures that the rôle of the muscles is in danger of being forgotten.

The Coronary Ligaments.—In the dissection of the knee-joint prepared to show the attachments of the coronary ligaments, the relative length of each is worthy of attention. That attaching the external semilunar cartilage to the tibia is 10 mm. long, whilst that attaching the internal semilunar is only 6 mm. This suggests that the external cartilage is allowed more mobility than the internal, and is possibly a factor concerned in the relative nfrequency of damage to this meniscus.

The attachment of each ligament one-eighth of an inch or more from the edge of the tuberosity is worth noticing. It would appear that a strain or injury could easily rupture a few fibres about the attachment of the coronary ligament, giving rise to hæmorrhage, organisation of the clot, and fibrous tissue, resulting in the formation of adhesions. It would seem likely that whilst a severe rotating force might completely rupture the attachment of the cartilage from the coronary ligament, a less severe force would give rise to a small tear and the subsequent formation of adhesions with slight thickening from the organised clot.

This conception of the pathology to my mind offers a likely explanation of those cases of injury followed by tenderness on the joint line and slight limitation of movement, but with no history of locking, which recover completely on forced mobilisation of the knee. In such cases some tearing of adhesions is felt on rotating the joint.

The preparations from formalin hardened knee joints, shown by Mr. Fisher,* show bands passing from one part of the fat pad to another; but from a consideration of these specimens, it would be difficult to co-relate them with the symptoms of which the patients complain. In my opinion, adhesions formed about the coronary ligament are the more likely cause of the condition.

The Internal Lateral Ligament.—This structure has been regarded by many writers as the key structure viewed from the standpoint of function. Its intimate relationship and connection to the internal semilunar cartilage has been insisted upon and has been accepted as the reason why this meniscus is damaged so much more frequently than the external.

In the drawing made from a dissected specimen (Fig. 1)—a coronal section through the joint—certain points in connection with the ligament and its relation to the cartilage merit attention. I would suggest that, contrary to the generally accepted teaching, the internal lateral ligament is a comparatively feeble structure. Its so-called superficial layer is nothing more than the continuation over the inner aspect of the joint of the deep fascia which envelopes the thigh and leg. This fascial layer is joined by

*Internal Derangement of the Knee Joint. London, 1924.

loose areolar tissue to the so-called deep layer of the ligament. The separation between the two layers is an easy matter and involves no cutting of fibres. In suggesting this I am fully aware of the many fallacies and difficulties which exist when any arrangement of fasciae is undertaken from an examination of dissecting-room or formalin-hardened specimens. The deep layer of the ligament is attached above to the inner aspect of the femoral condyle about one inch above the joint line. It is connected by definite bands which pass obliquely downwards to be attached to the superior border of the internal semilunar cartilage—a firm and definite attachment. The ligament passes down over the inner aspect of the joint separated from the cartilage by loose areolar tissue and finally blends with the periosteum covering the antero-internal surface of the tibia.

These layers—the deep fascia and internal lateral ligament proper—are blended to form the capsule as seen at an operation. After making the skin incision, the glistening capsule immediately comes into view. On dividing this structure there is a thick layer of loose fatty and areolar tissue —the extra synovial fatty layer—which must be divided before the synovial cavity is opened. It would seem that the operation findings bear out the view suggested above—viz., that the connection between the internal lateral ligament and the internal semilunar cartilage is less close than has been generally supposed.

MECHANISM OF PRODUCTION OF INJURY TO THE CARTILAGES

As has been called attention to above, there is, however, a definite connection between the internal lateral ligament and the internal semilunar cartilage. This only stabilises the posterio-lateral part of the cartilage. The anterior horn is less firmly held and is more movable. It is attached directly to the head of the tibia in front of the anterior crucial ligament to the transverse ligament, by the coronary ligament to the tuberosity of the tibia and loosely to the joint capsule. The fact that the posterior part of the cartilage is fixed and the anterior part relatively mobile is stressed by Keith, in Treves's "Surgical Applied Anatomy" (1918). In considering the mechanism the importance of rotation is emphasised. It is probable that the mechanism of the damaging force is not always the same—and a consideration of the attachments of the cartilage does not satisfactorily account for many of the lesions found at operation.

In my experience the differential diagnosis between injury to the ligament and injury to the cartilage is, as a rule, simple. It is not very common to find injury to the ligament and to the cartilage at the same time, whilst if it be considered that a tear or strain of the internal lateral ligament is the

first stage in the mechanism of cartilage injury this should be the rule. Again, one not infrequently finds the cartilage firmly attached around the periphery with a tear on its free border. It would seem, therefore, that there is a second and at least equally important factor at work, and that is the direct grinding or compressing force between femur and tibia. The circular shape of the external cartilage would safeguard it from injury whilst with the knee flexed and rotated, the shape of the long inner femoral condyle might reasonably be expected to press directly on the anterior part of the internal cartilage, when a tear could easily be produced.

It is generally recognised that the injury is most likely to happen with the knee flexed with the foot on the ground, and so with the tibia fixed. The large series of cases reported by Martin of Newcastle, occurring in miners, many of whom work in low seams in which it is impossible to stand upright, is conclusive proof that the damage to the cartilage takes place with the knee in the position of flexion. Certain other observers have attempted to prove that the injury occurs with the knee extended or during the act of extension, but this view has failed to gain many supporters amongst those surgeons who have any considerable experience of joint injuries.

Injury to the internal lateral ligament is caused by forcible abduction of the knee. It does not usually complicate injury to the cartilage but is a distinct lesion resulting from a different force—viz., direct abduction. It occurs particularly often in violent athletics, such as Rugby football, when a force acts directly on the outer side of the leg when the foot is on the ground. There need be no question of rotation or twisting. I do not regard injury to the internal lateral ligament or to the anterior crucial as any part of the mechanism of injury to the cartilage. Strain or rupture of the internal lateral ligament is a distinct clinical entity.

Anterior Crucial Ligament.—I would suggest that the mechanism of production of an anterior crucial ligament injury is most commonly associated with hyperextension of the joint.

Whilst, as has been previously stated, it is probable that the mechanism of the damaging force is not always the same, it appears possible to summarise the common mechanism of production of internal derangement. It would seem that forced abduction injures the internal lateral ligament; forced hyperextension the anterior crucial; and forced rotation the internal cartilage.

TYPES OF INJURY

An analysis of 316 patients, who presented themselves complaining of trouble in the knee joint, and whose records were sufficiently complete to

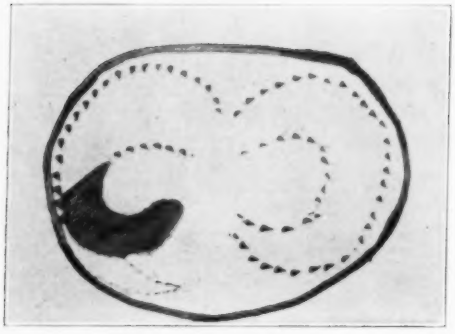

FIG. 2

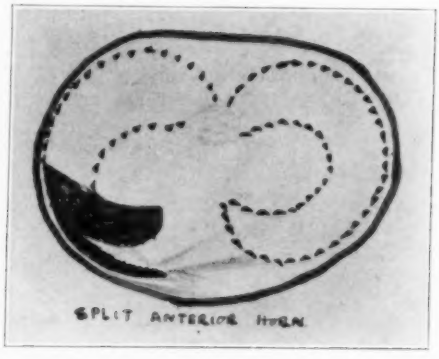

FIG. 3

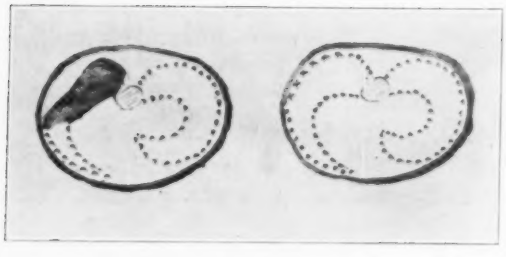

FIG. 4

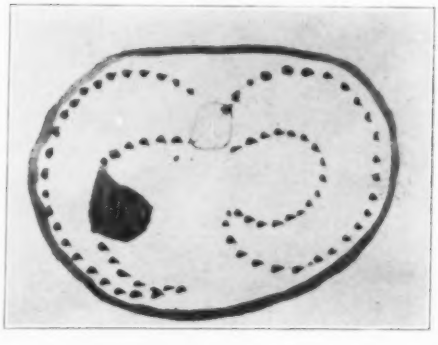

FIG. 5

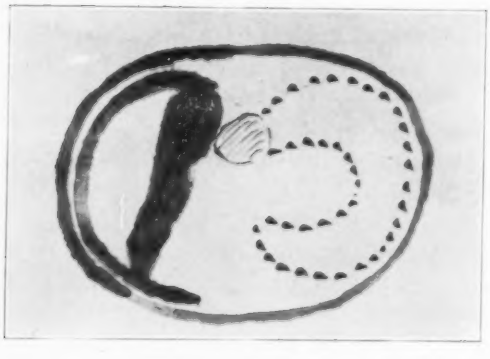

FIG. 6

Diagrammatic drawings of lesion of cartilage.

yield reliable information, gives seventy-seven cases of injury or apparent injury to the internal cartilage; and four cases of injury to the external.

Pathological findings of the injury to the internal cartilage were as follows:

Anterior end detached	32
Detachment from posterior half of coronary lig.—*i.e.* circumferential tear	9
Tag projecting into joint, usually from about the middle of the cartilage	8
Cartilage displaced into inter-condylar notch (bucket handle)	8
Cartilages normal	8
Cartilages normal, but hypertrophied fat-pad	5
Various, obscure	7
	77

The rough drawings reproduced (Figs. 2, 3, 4, 5 and 6)—were made at the time of operation and sufficiently explain the classification adopted. In Fig. 4 the small crosses indicate the tear in the coronary attachment, allowing the posterior half of the meniscus to be displaced inward across the joint as indicated by the shaded portion in the other part of the drawing.

Anterior end detachments exhibited several varieties:

Thickened (? due to old tear and new attachment).
Free, forming a small blob.
Free, turned back on itself.
Free, split into two or three portions.

Pathologic changes in the four cases of external cartilage injuries were:

2 anterior end detached and loose.
1 torn and with cyst formation.
1 posterior end loose—torn and displaced across joint.

Sir Robert Jones reports: Out of 117 cases operated upon (1906, 1907, 1908) for injury to the cartilage in which a lesion of the disc was found:

53 were torn from their anterior attachment.
16 were split longitudinally.
8 were attached by the cornua and torn from the capsule.
7 were displacements of the posterior horns.
12 were fractured transversely opposite the internal lateral ligament.
8 were loosely bound circumferentially, with no other appreciable abnormality.

8 had undergone changes in the loose anterior extremity of the semilunar of a nodular type, some being as lumpy and large as a pea.
3 cases exhibited no trace of the cartilage.
2 cases showed the anterior part doubled, and adherent to the posterior part.

Mr. Timbrell Fisher's figures give 38 per cent. longitudinal fractures and 33 per cent. detachment of anterior horn.

In a recent discussion at the surgical section of the Royal Society of Medicine, Sir Charles Gordon Watson laid special emphasis on the circumferential split and stated that he believed that in four out of five cases this occurred, whilst Mr. Whitelocke, of Oxford, found damage to the anterior horn the commonest lesion in his experience. There would seem to be no adequate explanation for this seeming discrepancy, excepting the fact that it is not always easy to say exactly what has occurred.

DIFFERENTIAL DIAGNOSIS OF INTERNAL DERANGEMENT

Accurate diagnosis presupposes and must be based upon a knowledge of the anatomy of the part and a clear conception of the pathologic state.

There are certain points which may be stressed as important when we are called upon to examine the knee-joint.

The History.—A clear and accurate history is essential, and is certainly of equal importance, if not of even more importance than any part of the physical examination. The question of previous accidents to the knee must be carefully gone into. The exact sequence of events when the accident happened—Did something in the knee give way and so cause the patient to fall? or did some external force or a slip cause the fall? If the former, then internal derangement is most likely. The question of locking, the degree of swelling and the rapidity of its onset are other points of importance.

It is not uncommon to meet a patient who comes complaining of trouble with the knee-joint and to find little or no evidence of anything abnormal on examining the knee, but in whom an accurately and carefully taken history suffices for the diagnosis of injury to the cartilage. I regard the history as so important that I would venture the statement that in a large number of instances the diagnosis can be made on the history alone.

Method of Examination.—Each surgeon will evolve his own method of examination, but it is wise to follow some routine, or points will be overlooked. The following procedure is employed by the writer.

The patient is examined with the lower limbs bare—no perfunctory pulling up of the trousers will allow of examination of the state of the quadriceps. He should be first seen standing and the knees regarded from both the front and the back, and then lying on the couch. Swelling of the joint or marked muscle wasting will be looked for.

Next he is asked to raise the leg with the knee extended whilst the surgeon resists the movement, and any muscle wasting as compared with the other limb is noticed and the muscle tone is estimated by direct pal-

FIG. 7

Showing fracture

pation whilst the quadriceps is thus in action. The joint is next palpated—any increased temperature, thickening of parts, or the presence of fluid being looked for. Lateral mobility and antero-posterior mobility in extension is next examined. It is to be noted that in semi-flexion the normal knee allows some lateral mobility, and only in full extension, therefore, is a slight lateral "wobble" of pathological significance.

Next the patient flexes the knee over the side of the couch and the joint line and the attachments of the ligaments are palpated. I would suggest that in my experience, and contrary to what is generally taught, it is the femoral and not the tibial attachment of the internal lateral which is tender on pressure when this structure is damaged. The antero-

posterior mobility of the knee in flexion is tested and grating on movement is felt for.

The full range of movement active and passive is examined. Finally the patient is asked to do a "heels raise, knees bend," and if no gross abnormality is discovered, to run and to hop on the affected leg.

X-ray Examination.—This is to be regarded as a routine part of the clinical examination and is essential to accurate diagnosis. A roentgenogram should always be examined before any operation is undertaken on

FIG. 8

Lateral radiogram after operation.

this joint. Roentgenograms are reproduced of a patient whose injury might reasonably have been regarded as a displaced cartilage. He was playing Association football—ran with the ball—trod on it, and fell. His knee locked 30° short of full extension. An attempt to manipulate it straight failed. There was swelling which had come on rapidly, and pain on pressure on the joint line. Ten days after the injury, when I first saw him, I think the diagnosis which would most likely have been made was a dislocated internal cartilage. The skiagram revealed an avulsion fracture of the tibial spine, a large fragment being displaced into the front of the joint and blocking extension (Fig. 7).

Figures 8, 9 and 10 show the after result in this case. The knee was approached by the split-patellar route, and bone gouged out from the head of the tibia, in order that the elevated fragment with its articular cartilage could be brought back into position.

FIG. 9

Showing degree of controlled movement after operation.

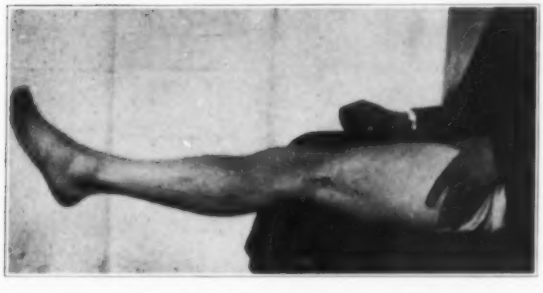

FIG. 10

Showing degree of controlled movement after operation.

Figure 8, the lateral picture taken some months later, shows the knee to be in full extension and that the bone block is no longer occurring.

Figures 9 and 10 show the range of voluntary controlled movement ten months later, and it is of interest to relate that the patient was playing

cricket at Lords two days ago, and has regained practically full use of the knee and is not incapacitated at all.

Removal of the projecting bone and articular cartilage would have resulted in a knee with a very limited range. The question as to whether or not he will ultimately suffer from a traumatic arthritis does not concern us here, but it is wise to be guarded as to the ultimate prognosis with advancing age.

I have experienced this fracture three times in my own cases, when but for the X-ray I should have wrongly diagnosed a lesion of the cartilage.

The differential diagnosis for practical purposes and for the purposes of our present discussion amounts to this.

Is the patient suffering from an injury to the cartilage? And to answer the question we must exclude the following disorders which may give rise to somewhat similar symptoms—

1. Loose body.
2. Quadriceps insufficiency.
3. Enlarged or injured retro-patellar fat-pad.
4. Ruptured lateral ligament.
5. Injury to anterior crucial ligament.
6. Adhesions.
7. Slipping tendon.
8. Joint disease—early arthritis, "rheumatic," or tuberculous.
9. Intra-articular fracture.
10. Fractured patella.
11. Recurrent dislocation of patella.

This list could be added to, but is in the main fairly comprehensive.

Is it possible to diagnose an injured cartilage in the absence of a history of locking? I am aware that opinions differ on this point, but I do not personally regard such history as essential—locking is usual but not invariable. When one comes to analyse the symptoms of these other conditions, there may be real difficulty, but in the majority of instances there is none if the history is carefully taken and the clinical examination is thorough.

A *loose body* cannot be distinguished with certainty unless it be felt by the patient or the surgeon, or is visible in the skiagram, although a careful consideration of the history will suggest this condition.

The points which favour loose body are briefly (*a*) True locking lasting only for a moment, with easy reduction on any movement of the knee; (*b*) Pain on locking referred to different parts of the joint on different occasions.

I do not regard locking without accident as evidence of loose body more than of torn cartilage, because with the latter condition one sometimes

gets a history of derangement when the patient is lying in bed and merely turns or twists the knee.

Another condition which demands our attention is *quadriceps insufficiency*. The weak wobbly knee which gives way, is the subject of recurrent attacks of synovitis, is weak and untrustworthy—which weakness is particularly noticeable on coming downstairs—is often ascribed to a damaged cartilage. Short of a definite history of locking, and locking which requires manipulative interference, the diagnosis of cartilage trouble should not be made when the quadriceps is wasted and lacking in tone. Such a patient should be treated as suffering from muscle insufficiency. If there be a recurrence of the symptoms with the muscles in good condition, internal derangement is suspected.

The *nipping of the retro-patellar* fat-pad may be mistaken for a cartilage injury. The state of affairs on examination may be precisely similar in these two conditions. There may be a history of locking, which is somewhat indefinite, and the pain is experienced along the joint line and is not restricted to the front of the joint.

One can recall cases in which the diagnosis of injury to the semilunar cartilage seemed well-nigh certain, and yet no lesion could be found on exploring the knee-joint. I suggest that injury to the fat-pad, which overlies the front of the cartilage, is the probable cause of disablement in these cases, and that its removal will result in amelioration of the symptoms.

There is a described lesion which I have purposely omitted from the list—viz., *nipping of a synovial fringe*. This is a time-honoured description which occurs in all the books as a clinical entity which must be distinguished from other disabilities of the knee; but does it exist? Has anyone come across such a case? Nipping of the retro-patellar fat-pad is a different condition, but one does not meet with synovial tags or fringes. They are present to some extent in villous arthritis, but do not give rise to any symptoms comparable to internal derangement.

Rupture or Strain of Lateral Ligament.—This has been already referred to when discussing the mechanism of production of internal derangement. No difficulty should arise in arriving at the diagnosis. There may be a marked limp—pain generally over the femoral attachment—synovitis, but with a history of direct injury to the outer side of the leg, and of no locking. The joint line is not usually tender on pressure.

Injury to Anterior Crucial Ligament.—The diagnosis of this condition should present no difficulty if the examination is carefully made. The anterior crucial is injured by hyperextension of the knee-joint. It is a rare injury in civil life. It was common in the war, where, as a rule, it

followed on a severe accident, such as the man being blown up by high explosive or buried. It is not usually associated with an injury to the cartilage. The fact that many cartilages were explored and removed in both soldiers and pensioners, who derived no benefit because the crucial was at fault, is no criterion that the two lesions are associated.

Adhesions.—The formation of adhesions following an injury or tear about the attachments of the cartilage is a common event. The differential diagnosis of adhesions and a torn cartilage is in practice only made by a consideration of the history. It is not possible in any given case which presents signs of adhesions to exclude an injury to the cartilage which will subsequently recur and require operative attack, even when the adhesions have been satisfactorily dealt with by forcible manipulation.

Slipping Tendon.—May give rise to symptoms of "locking," but the lock is momentary and is easily reduced by the patient himself. No joint effusion follows and tenderness over the joint line is absent. The roentgenogram may show the exostosis over which the tendon slips. I have met with the condition two or three times, and it has given rise to no difficulty in diagnosis.

Arthritis.—There is a need to consider the differential diagnosis of a mild arthritis from an internal derangement. With care and experience no difficulty should arise, but it seems to me advisable to call attention to the condition in this connection. During the war and after the war, many knees were explored, which were examples of a mild subacute arthritis.

The condition is characterised by vague symptoms, of which the most usual is pain, stiffness, and some synovitis on over-use. This is followed by muscular weakness and a feeling of insecurity. The patient may state that the joint gives way—feels weak particularly on coming downstairs or downhill. There is not very much to be made out on examination, except quadriceps insufficiency, some coarse grating, whilst forced extension may give rise to pain. The joint is one which will allow of moderate use, but will not tolerate over-use.

Intra-articular Fracture will be diagnosed by means of the X-ray examination. It is laid down in the literature that there is a distinct difference in feel between a bony and fibrous blocking of extension. I have no personal experience as to the value of this test. In my own series I have met with this condition on three occasions and have not suspected it; and only on examining the X-ray picture was the true state of affairs revealed. As stated above, I regard X-ray examination as an indispensable prelude to any operation on the knee-joint.

Fracture of the Patella without displacement will be diagnosed by a con-

sideration of the points of tenderness on pressure, and by X-ray appearances. It is necessary to bear in mind that a patient may present himself, complaining of pain in the knee, but still able to walk into the room if this fracture has occurred sub-periosteally and without displacement of fragments.

Recurrent dislocation of patella. It is not always easy from a consideration of the history to exclude the possibility of this lesion. As a rule, the joint line is not tender on pressure, the quadriceps is lax, and when the knee is examined extended on the couch, it is easy to push the patella over the outer femoral ridge.

In the case of those patients in whom it is difficult to arrive at a satisfactory diagnosis, the method of procedure which I adopt is to put them on to a course of free gymnastic treatment, under skilled supervision, in the hope that the lesion may become apparent. The patient will probably reproduce the symptoms of which he comes complaining.

In doubtful cases, when one is not sure whether it is a patella which is slipping, or a cartilage which is at fault, investigation carried out in this way is most valuable and may well be essential to arriving at a satisfactory conclusion.

TREATMENT

The treatment will depend upon an estimation of the pathology of the actual condition of the knee-joint at the time of the examination, and may for convenience be considered under three headings.

1. *Patients seen within a few days of the first accident.*—The dislocation must be reduced by manipulation, under anæsthesia if necessary. The subsequent treatment is a matter on which opinions vary, and which allows of discussion.

What is the rationale of the subsequent treatment? Are we attempting to allow of repair of a tear of the meniscus itself or of its attachments? If so, then absolute fixation and relief from weight-bearing for some weeks would appear necessary. No half measures will suffice. But if a knee-joint which has been injured is placed at rest, and kept at rest for some weeks, two things will happen: (*a*) muscular wasting; (*b*) the formation of adhesions.

The wasting will be both "reflex," the direct result of injury to the joint, and from disuse. Adhesions must result from hæmorrhage—organisation of clot and the formation of fibrous tissue.

Now, does the treatment outlined above result in repair of the cartilage, if this is torn? It is at least doubtful (Fig. 11). Tears or injury about the

periphery of the cartilage and at its attachment to the coronary ligament can of course heal perfectly well. On the other hand, a tear of the free border with displacement of a tag towards the centre of the joint will probably be unaffected by any immobilisation. In view of this, is it worth while from the standpoint of function to condemn the patient to three weeks' enforced rest and recumbency or relief of weight-bearing, and to the further period of after-treatment necessitated by the muscle deficiency and adhesions?

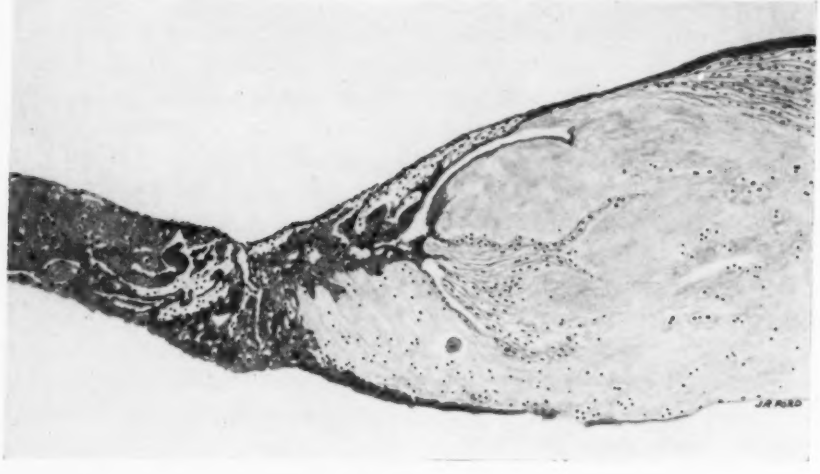

FIG. 11

Section of injured semi-lunar cartilage, showing changes about site of injury. At one point, probably the injury, there is great activity from connective tissue cells while the cartilage is broken up into small islets and vacuolated areas. The cartilage at this point is very atypical and has a much greater affinity for eosin than normal cartilage. The line of damage is sharp and very distinctly marked off from the rest.

The alternative line of treatment, which I personally adopt, is to make every attempt from the earliest possible moment to regain normal function in the injured limb—*i.e.*, to restore full muscle-power and full movement to the knee. The patient is allowed to walk, and carry out his habitual occupation, providing it is not too strenuous. A pressure bandage is applied for 24 or 48 hours to check the synovitis, faradic stimulation to the quadriceps is commenced, and the patient encouraged to regain full movements by exercising the knee.

2. *Patients seen some weeks after the First Accident.* Treatment will depend upon the symptoms complained of, and upon the surgeon's appreciation of the pathologic condition giving rise to these symptoms. For convenience, we will consider four illustrative cases.

Case 1. The patient has recovered from the injury but complains that the knee gives way through weakness. On examination there is obvious wasting of the quadriceps muscle, and perhaps some fluid in the joint. There is no tenderness, no synovial thickening, and movements are full and painless, and no abnormal mobility is detected.

The diagnosis is "*quadriceps insufficiency.*" And the treatment is to restore muscular power by faradic stimulation and to teach the patient how to brace up the quadriceps. As the muscle gets stronger, the patient is encouraged to ride a push bicycle and to perform "heels raise, knees bend" exercises.

Case 2. The patient has recovered from the injury, but complains that the knee gives way on account of pain. On examination, there is local tenderness somewhere over the joint line, and the normal movements are limited in full flexion by pain. In addition there is slight muscular wasting, but no other evidence of anything abnormal. The diagnosis is "*Adhesions*" and the treatment is by mobilisation under an anæsthetic. Subsequently, the muscular power is restored by the means outlined under Case 1.

The question is sometimes asked—Does manipulation under anæsthesia result in the "cure" of a cartilage which is torn? It is probable that it does; and it is quite possible that some split cartilages displaced across the joint are permanently relieved by forcible manipulation, even when the displacement is of the "bucket handle" type. If the central portion of the torn cartilage which lies across the joint be ruptured by forcible manipulation, the ends may well retract and, lying in the inter-condyloid notch, give rise to no further symptoms.

It is not possible to say whether this will happen or not; but it is fairly certain that it does, as we all meet with cases of definite cartilage injury which are cured by manipulation. At the same time, it must be borne in mind that the vast majority of such displacements are not so cured, and that a recurrence of symptoms after simple manipulation of the knee is likely.

Case 3. The patient has recovered from the injury, but complains that although his knee is good enough for ordinary work, yet it will not stand prolonged strain. He can ride a bicycle or walk reasonably; but if he attempts to play tennis or a second round of golf, the knee swells, be-

comes weak, and feels as if it would give way. There is no locking, but the feeling of weakness after exercise is marked. Moreover, the knee tends to become stiff and be a little painful if kept for any length of time in one position—for example, sitting in the theatre or a railway carriage, and the patient on these occasions feels as though he must get up and stretch the leg.

These symptoms are indicative of a commencing arthritis. Any possible cause must be eliminated, and the condition treated by appropriate means.

Case 4. The patient has not recovered from the injury and complains of weakness, and pain on using the knee. On examination, extension is limited by 10°, and forced extension is painful. There is tenderness on pressure over the joint line on the inner side. The diagnosis is "unreduced dislocation of the cartilage." Treatment calls for reduction by manipulation, or removal of the cartilage by operation.

3. *Patients with a history of recurrent locking.* Repair of the cartilage cannot now be expected. The torn edges are smoothly rounded off, and the torn tag is liable to be continually nipped between the joint surfaces. The removal of the torn portion by operation is indicated.

PRE-OPERATIVE TREATMENT

I would wish to call attention to the need for pre-operative treatment in those cases of knee injury which are complicated, as most of them are, by wasting of the quadriceps. As has been pointed out, it is difficult to be sure of one's diagnosis in the presence of marked quadriceps insufficiency.

In those cases in which it is clear that there is definite internal derangement from a consideration of the history, but in which there is no block to extension when the patient is examined, a course of muscle training and muscle development is, in my opinion, of the greatest value before operation is undertaken.

The length of the convalescence is markedly decreased, the stability of the knee following operation is immeasurably better, and from every point of view, the patient will gain. I suggest that the muscles should always be put into as good shape as possible before operation.

If, when the patient is examined, extension is incomplete, operation should be undertaken and freedom of this movement restored, no matter what the state of the musculature, as it is impossible to have a normal quadriceps if extension is blocked by intra-articular derangement.

THE TECHNIQUE OF OPERATION

Rigid attention to asepsis is the first essential. It is not my intention to go over in detail the steps in the operation either as regards the preparation of the patient, towelling off the wound and so forth; but attention will be called to certain factors which may make all the difference between success and failure in operating on the knee.

The Tourniquet. The use of a tourniquet is essential in order to obtain a clear view of the various structures when the joint is opened. I do not believe its use ever does harm. Post-operative hæmorrhage and the resulting hæmarthrosis is a rare event, if the dressing and bandages be firmly applied. Moreover, the stitching of the synovial membrane and capsule in two layers, as is the usual custom, will to a large extent act as a hæmostatic suture.

The Incision. Any incision which gives a sufficient exposure will be adequate—whether curved or straight, oblique or transverse. The individual preference and experience of the operator will be the deciding factor. The incision must not necessitate any dividing of the lateral ligaments.

The lateral incision suffices for the majority of cases. In the event of a more complete exploration of the joint being called for, the split-patellar route, or the displacement of the patella will give a better view. But *there is no need to split the patella or turn it aside to remove a torn or displaced semilunar cartilage.* The operation is more severe, the convalescence longer, and in actual practice the lateral route is, in my hands at least, the more convenient. The split-patellar route might be reserved for those cases of avulsion or other fracture of the tibial spine, for injured crucials, or for those cases in which the fairly complete exposure of an arthritic knee, or the presence of several loose bodies, will render such procedure advisable.

In some of the discussions in this and other societies, speakers have stressed the need for opening the various layers—deep fascia, capsule, extra synovial layer and synovial membrane—in a particular way; that the opening in the capsule shall not lie immediately under the skin incision, and so forth. This seems to me a matter of no moment—division of skin, next of capsule, and then straight through the extra synovial fat and synovial membrane takes a few seconds, and may be directly performed. The exposure must be adequate, for it is very essential that no rough handling be permitted. Clean cutting with a knife without heavy retrac-

tion should be the rule, and bruising of the joint lining or injury to articular cartilage must be carefully guarded against.

Estimation of true state of affairs on looking into the joint. Whilst in the majority of cases the actual site and extent of any damage to the cartilage is evident on looking into the joint, I do not think it is possible in every case to say exactly what has happened. For this reason I suspect that some of the tables which refer to circumferential tears, loose anterior horn, and so forth, are possibly not so enlightening as they appear.

The gross findings at operation may be roughly classified as follows, as we are confining our attention to cases which may be mistaken for internal derangement, and so excluding gross disease—*e.g.*, villous arthritis, marked osteo-arthritis, and the like.

1. Definite injury to semilunar cartilage:

(*a*) Detachment and displacement of anterior horn.

(*b*) Oblique split projecting into joint, generally at junction of anterior and middle third.

(*c*) Circumferential tear with cartilage displaced across joint, or lying in normal position, but loose in posterior half or two-thirds.

(*d*) Cartilage completely detached, and rolled up in intercondylar notch.

2. No injury to semilunar cartilage, but—

(*a*) Enlarged retro-patellar pad of fat.

(*b*) Hypermobile cartilage—if this exists, which is a matter for discussion, and on which different surgeons hold different opinions. I regard this diagnosis as a refuge for the destitute in most instances.

3. Injury of the joint apart from cartilage injury:

Erosion of articular cartilage, with or without injury to or displacement of the semilunar cartilages in addition.

4. Split fracture or avulsion fracture of head of tibia.

5. Loose bodies.

6. No abnormality.

Procedure to be adopted when the joint is opened. If there is an obvious lesion of the anterior half of the cartilage, this should be separated from its coronary and other attachments and gently pulled on. If the posterior part of the cartilage has been detached, it will slip across the joint, whilst if normal it will remain in place. The manoeuvre should be quite gentle; no hard pulling is necessary or desirable. If the posterior part of the cartilage is obviously firmly attached, it will suffice to remove the anterior portion. In fact, unless the posterior attachment has been torn, it is a most difficult procedure to remove the whole cartilage, and attempts to

do so will probably injure the joint, forcible retraction and fairly wide division of the capsule being necessary. I do not believe that the posterior part of the cartilage can give rise to trouble *when normally attached* or, at any rate, that it only does so in most exceptional circumstances. I am aware that this view is not generally held.

2. If the anterior half of the cartilage appears normal, it should still be removed, as only by so doing can the state of the posterior part be adequately determined. If the anterior attachments and the anterior half of the coronary are divided, with a lesion of the posterior part, the whole cartilage can be gently pulled towards the middle of the joint, proving that the posterior attachment of the coronary had been torn, which lesion is not visible until the anterior half of the cartilage has been freed. Reference to the diagram Fig. 4 illustrates a case in point.

3. If the anterior and posterior attachments are both normal, in other words, the removal of the anterior half has obviously not affected the condition, what is the next procedure? This will depend upon the confidence which the surgeon has in his diagnosis. If he is convinced that the symptoms are caused by a cartilage lesion he should without doubt open the joint on the outer side and inspect the external cartilage; whilst if the state of affairs was uncertain he may content himself with removing any evident enlargement of the fat-pad and closing the joint.

Opinions vary as to whether or not the external cartilage can be examined from the incision usually employed to remove the internal. I do not myself believe that any satisfactory view of this attachment can be made from the incision on the internal side, and I therefore think that a separate incision on the outer side of the knee is necessary.

The operation findings in one of the cases in my series is worthy of mention. A schoolboy aged fifteen had a definite history of cartilage injury, and we explored the joint and removed a torn internal semilunar cartilage. On opening the joint a large number of small ovoid bodies, white in color and the size of melon pips, came out of the joint. It was questioned whether these bodies were cartilage or organised fibrin. On microscopic examination they proved to be cartilage (Fig. 12). No attempt was made to remove them all—indeed this would not in my opinion have been possible. The after history has been uneventful so far—two years have elapsed since operation, and the boy is playing cricket.

Professor Dudgeon's report on the small bodies and on the synovial membrane of the knee is as follows:

"*Synovial Membrane.* There is a large amount of old blood pigment resulting from previous hæmorrhage in the sub-endothelial tissue lining

of the joint membrane. One tag of fibrous tissue membrane present in which there is also old blood pigment. There is no evidence of chronic inflammation except at one focus. The loose bodies consist of cartilage covered with synovial membrane from which the cartilage is derived, as it is quite possible to trace the connection between the fibrous cells of the deep synovial membrane and the true cartilage tissue. Some of the cartilage cells have degenerated, but mostly they are in good and active state "

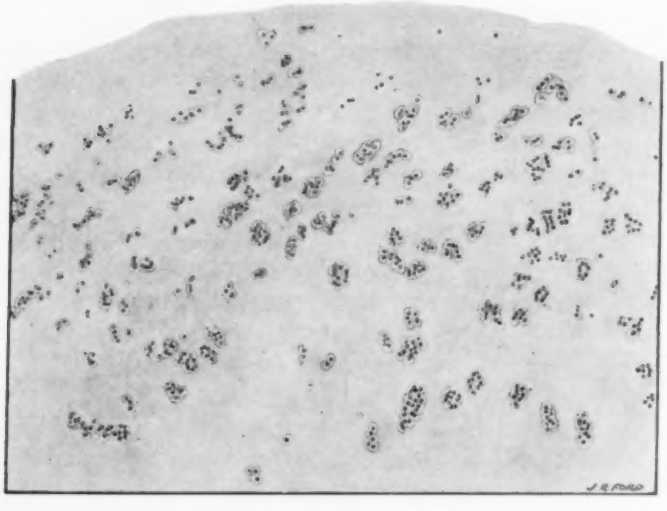

FIG. 12

Section of one of the small loose bodies removed.

POST-OPERATIVE TREATMENT

No splint is needed. A pressure bandage is applied whilst still on the operating table, and as this is applied very tightly at the time, it is sometimes necessary to loosen it at the end of twenty-four to thirty-six hours, as the retention of a very tight bandage gives rise to much discomfort.

Electrical stimulation of the quadriceps is commenced on the seventh day, and the patient is encouraged to contract the quadriceps muscle voluntarily. Stitches are removed on the eighth day, and the patient gets up. It was formerly my practice to get the patient up earlier than this, but I do not think, on the whole, that his recovery was expedited.

If there is fluid in the knee when the stitches are removed, he remains in bed for two or three days. His first efforts at walking are controlled by the masseuse who undertakes the electrical treatment. He is taught to place his weight equally on the two feet; to take an equal length of stride with each foot, and so forth—a series of minor points, but attention to which makes a considerable difference to the rapidity of convalescence. In three weeks he should be able to resume a normal active life, but I usually advise that he should not take part in games for a month to six weeks.

In a recent discussion which took place at the Royal Society of Medicine, certain surgeons referred to the fact that no post-operative treatment was necessary, and particularly laid stress upon their opinion that patients should not be sent to the massage department. The question of post-operative treatment merits discussion, but I am firmly of opinion that it is absolutely essential in the best interests of the patient. I have personally the greatest belief in the efficacy of electrical stimulation of the quadriceps if this can be carried out intelligently, and that muscular contractions against slight resistance is another very helpful method for use alone or in conjunction with the former. I would condemn the practice of performing the operation and allowing the patient to work out his own salvation in his own way, unassisted by the best that physical treatment has to offer.

END RESULTS

For the paucity of the end results I wish to make apology, but of several hundred cases operated upon we have so far been able to trace the end results in only 39. We have attempted to do so in only those cases in which we have an accurate history and an exact account of the pathologic condition found inside the joint at the time of operation.

We have left out all cases of loose body, and each case has been examined within the last twelve months. Some of them are comparatively recent, but we have included no cases operated on this year.

Of these thirty-nine cases, thirty have given excellent results. By this is meant that the patient is able to take part in games and that he is not inconvenienced in the least from the original injury to his knee or the subsequent operation. In each case he states that the knee is as good as the normal. Many of these patients are playing first-class games, and this bears out what we all believe—namely, that the knee operated on for an injury to the cartilage and without other changes, gives a perfectly good

result. I think it is necessary to insist on this point, as there is a good deal of loose talk about knee joints, and patients so often volunteer the statement that they have been told they will have a stiff knee if the joint is opened.

The six results classified as fair would in most tables, be called good, as all these patients play games, but state that the knee is not quite as good as on the other side—generally that it is not as strong.

Of the unsatisfactory results one was a girl who was unable to carry on with physical training on account of recurrence of symptoms; but in her case nothing abnormal was found at the time of operation, and it is likely that this was an example of early arthritis, and that it was a knee which would allow of ordinary, but would not put up with over-use.

The second unsatisfactory case was a definite tear of the external cartilage, and I thought at the time that the man would do perfectly well. He came back eighteen months later, as the knee would not allow him to play football, gave a history of rather indefinite locking, and complained that the knee was not as good as on the other side.

The second exploration in his case revealed an enlarged and fibrosed fat pad. An examination of the synovial membrane revealed chronic inflammation, marked thickening with fibrosis, the presence of old hæmorrhage and the replacement of the fat pad to a large extent by fibrous tissue. So far, the result of the second operation has been satisfactory, but the time has not yet been sufficiently long to enable us to report the result as successful.

The third unsatisfactory case reports that his knee is not as good as the other, but that he is able to play hockey and tennis; that the knee has given way on two occasions without locking. In his case there was a definite tear of the internal cartilage together with erosion of the condyle. I regret that I do not know the state of the synovial membrane, as at that time we were not investigating this structure microscopically as a routine procedure.

I would call attention to a case in which nothing abnormal was found at the time of operation, although the history was quite definite. The knee had been "out" several times, had definitely locked, and the locking could not be reduced by the patient. The anterior two-thirds of the internal cartilage was removed in this case in order to make sure that the posterior part was not loose; but nothing found at operation satisfactorily accounted for the symptoms. This boy has had no trouble since, although it is difficult to see in what way the operation helped him.

The conclusion that I would draw from the investigation of these

cases is that in the vast majority of patients removal of the semilunar yields a perfectly good result.

The end results of the operative treatment of internal derangements of the knee joint in St. Thomas's Hospital, 1912-1921, were collected by Mr. Mitchiner, and reported on in the Hospital report. He found that 76% of cases in which a definite lesion of the cartilage was noted at the operation gave good results. Certain of his conclusions, however, cannot, I think, be allowed to pass uncriticized, as this paper has been referred to on more than one occasion, and appearing as it did in the annual reports of a large teaching hospital, will presumably have a wide circulation. He suggests that, "as regards the actual route selected at operation, the transpatellar is the most satisfactory in all respects." With this I cannot agree, and am firmly of the opinion that this method should be reserved for certain definite selected cases, and should not be the routine procedure.

Secondly, "that the full benefit of operation is not to be expected for from two and a half to three years after its performance." In this connection it is worthy of note that Osgood, in the report on 181 cases operated on at the Massachusetts General Hospital, found that nearly four months was the convalescing time for hospital patients, but the average time for private patients was one month. He considers "a private case spends more time and effort in regaining strength and motion." There are, of course, other factors of importance.

Thirdly, Mitchiner's conclusion that "when nothing abnormal is found on the joint being opened, the best course to adopt is to close the joint without interfering with the intra-articular structures" is again open to criticism. As already pointed out, and as the President always insists, it is very often impossible to say what has happened to the posterior attachment of the cartilage until the anterior has been removed. I have called attention to the report of the St. Thomas's cases because some discussion on these points would, I think, be of value.

With regard to the investigation of the synovial membrane, I regret that nothing much of interest in connection with the cartilage cases has resulted. In the older people there is often a little fibrosis, but in the main the synovial membrane is normal.

With the kind assistance of Professor Dudgeon, I am showing an average synovial membrane from one of these patients and at the same time contrasting it with that of a villous arthritis, in order to compare the intense chronic inflammation of this structure with what we find in the type we are discussing.

In infective arthritis, in rheumatoid arthritis, and to some extent in

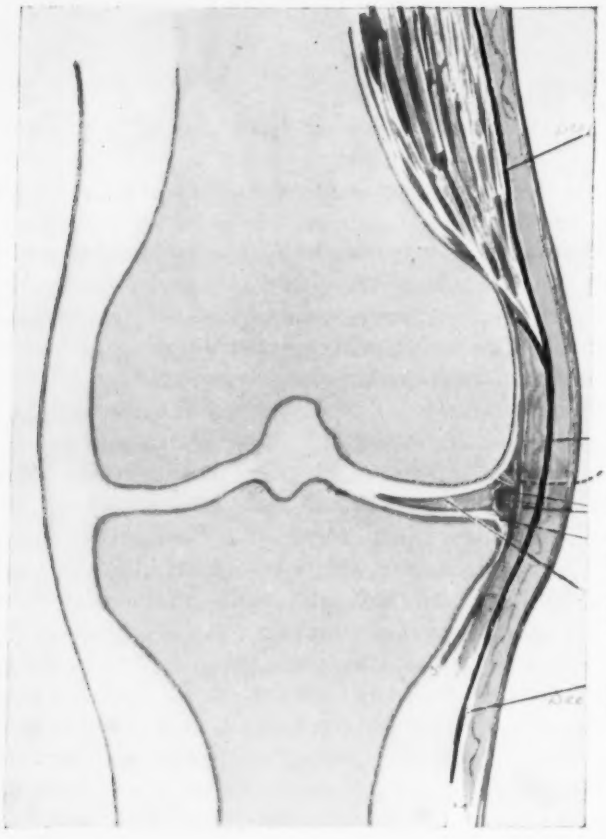

FIG. 1

Drawing taken from section of knee joint, showing arrangement of deep fascia, and of the internal lateral ligament.

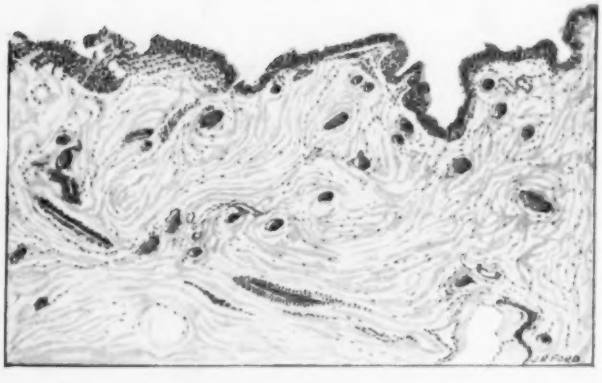

FIG. 13

Synovial membrane from an average case of internal derangement, showing the endothelial lining, an average number of blood vessels and the fibrous tissue stroma. Contrast with Fig. 14.

FIG. 14

Synovial membrane from a case of villous arthritis of knee, showing most intense inflammatory reaction. Large areas of lymphoid and plasma cells, extending throughout the tissue and collected in large masses. Superficial and deep. Vessels *thickened* and congested.

osteo arthritis, the results of this investigation are of very great interest, and we think they are likely to be of some importance. The communication of the result of the complete investigation will be made at a later date.

INTERNAL DERANGEMENT OF THE KNEE-JOINT

GENERAL DISCUSSION

Sir Robert Jones said that the work of recent investigators tended to prove that the internal lateral ligament was not so firmly connected with the internal semilunar cartilage as was hitherto stated. Keith, Fisher, and others had emphasized the fact that in most cases the prominent anterior part of the ligament was but loosely attached to the cartilage, and the structures were very easily separated. The short deep fibres of the ligament were attached to the meniscus at its peripheral border just behind its centre. Bristow, subscribing to this, looked upon the superficial layer as a mere continuance of the deep fascia which covered the thigh, and was joined to the deeper layer by means of areolar tissue. Sir Robert could not agree with him that this ligament was a comparatively feeble structure. The experiments of Timney and others gave proof of its strength. All agreed that a portion of the ligament kept a firm grip upon the centre and posterior part of the cartilage. Most experienced surgeons would agree to this from the clinical aspect, as this attachment was one of the obstacles met with in removing the cartilage. That this close association between ligament and cartilage influenced the pathology of the lesion was clear, especially as regards displacements of the anterior cornua and longitudinal and oblique tears. The question of the mechanism of injury to the cartilage was still open to discussion. In his opinion displacements of the internal semilunar occurred when force was applied, the knee being flexed and the femur rotated inwards or the tibia outwards. It never occurred during extension, except when great force was applied to the outer side of the knee, and then the ligament was usually severely injured. In extension the cartilages were tightly held between the articular surfaces, and the ligamentous attachments were free from strain. During flexion the coronary ligaments were stretched. A twist was in the great majority of cases an essential element, and abduction could not be dissociated from it. Any and every type of injury to the cartilage might be produced by these movements. One must remember, however, that a small percentage of cases occurred where the same sequence of movements had produced a displacement of the external cartilage. Transverse and oblique fractures

often occurred when a weight, such as coal or stone, fell directly upon the thigh while the knee was flexed. He quite agreed with Mr. Bristow that displacement of the cartilage generally occurred without a rupture of the internal lateral ligament, but when displacements occurred in the athlete a considerable strain was placed upon the ligament, and if a case were examined soon after the injury there was often considerable pain over the femoral attachment of the ligament. Recurrent displacements might occur without strain of the ligament. It was not surprising that the internal semilunar cartilage was displaced more frequently than the external. Apart from the "give and take" mobility of the external cartilage, due to its weak ligamentous attachments, the knee could not be rotated inwards sufficiently to put a strain upon the attachments of the external cartilage as pointed out by Turner. In flexion the external lateral ligament was more relaxed than the internal, and offered no obstruction to inward or outward rotation. The internal lateral ligament allowed a certain amount of external rotation and then became tense. Thus it checked strain upon the external cartilage. Again the rotation of the knee inwards was less than outwards in every degree of flexion. The ligament that effected this was the anterior crucial which was tight when inward rotation was made. Apart from the anatomy and attachments of the internal semilunar it should be remembered that the foot was abducted in normal walking, and in most movements strain was thrown on the ligamentous structures on the inner side of the knee. This all favoured internal rotation on the femur upon the fixed tibia, the usual cause of displaced internal semilunar.

With greater experience Sir Robert had become less dogmatic in regard to differential diagnosis, and this was largely due to the fact that what were known as the classical symptoms of displacement were frequently not present. The classical train of symptoms should include the history of incidence of body weight, locking, site of pain, both objective and subjective.

If time had elapsed after the accident the patient was often unable to be of much help. Information could often be obtained if inquiries were made as to how he walked, whether he was easier if he turned his foot in, whether he felt pain if his abducted toe struck a light object, such as a stone. If the accident was not too remote very important information could be gained by flexing the knee and rotating the tibia outwards, or by forcibly extending the knee. Pain was then usually referred to the site of injury. This was often intensified if, when the knee was flexed, a finger was pressed into the hollow, just internal to the patella and on the line of joint, and the knee then extended. If all these symptoms were present the diagnosis became positive, but some of them were generally absent. We had then

to proceed cautiously, and often the patient had to be made to perform acts designed to reproduce the displacement. The patient would be directed as to what to observe and to come straight to the surgeon immediately the displacement recurred. The diagnosis then became easy. It was, in fact, an experiment under observation. There was not one symptom in itself diagnostic. Locking could occur from a nipped loose body pedunculated or otherwise, from blocking of a tibial spine, from a slipping of a hamstring over an osteoma, or from a biceps over the head of the fibula. With ordinary care there was no difficulty in excluding these. Every case should have radiograms taken. The difficulty was to know when we are justified in operating. The rule he laid down many years ago he still adhered to, *i.e.*, not to operate when there had been no recurrence of the displacement. A large proportion of cases never did recur.

Sir Robert was convinced that if a patient presented himself soon after a dislocation had occurred, the knee ought to be kept at rest extended, until the structures had had a chance of uniting. That union did occur was beyond doubt, but it could not take place under three weeks. With massage, and voluntary muscular exercise in a splint, and the addition of electric stimulation, the muscular tone could be quite sufficiently preserved. Later he should walk so that body weight was deviated from the internal lateral ligament. In recurrent cases a rest was rarely indicated unless called for by the degree of trauma.

With operative details all were acquainted. If the symptoms were mainly classical an exploration should be made and the defect searched for. If a fractured anterior end were loose in the joint, and the remainder were firmly attached, removal of the loose piece was sufficient. The same could be said of the longitudinal tear resulting in a bucket handle displacement. If, on operation, following classical symptoms the cartilage appeared to be normal and no other abnormalities were found, the cartilage should be removed, for by this a slit was often found, which could not be seen until the cartilage was drawn to the centre of the knee. Many a joint had been closed without taking this precaution. If in any doubt as to the attachment of the posterior part of the meniscus, the cartilage should as far as possible be removed. The small portion of the posterior horn usually left behind did not give rise to trouble. There could be no doubt that a preternaturally mobile anterior horn did exist, and did give rise to symptoms. Such cases were not even very uncommon. One sometimes found a cartilage on these occasions with serrated edges, and often with pink nipped fatty pads. Sir Robert said he had some years ago operated upon over 2,000 cases, and had experienced disappointments, some of which he was wholly

unable to explain, and some of which were due to faulty technique. Septic complications should, of course, never occur. On two occasions he had experienced trouble from hæmorrhage of such severity as to point to hæmophilia.

The cases which were so often reported as cured by manipulations were usually adhesions, which occurred from hæmorrhages about the coronary ligaments and infrapatellar pad. The subsequent histories of cases cured by manipulation proved that a large number recurred. Football professionals, in view of that fact, often asked that their cartilages should be removed rather than be manipulated. The fact, however, remained that manipulations did sometimes effect a reduction of a permanent kind in recurrent cases when the surgeon would have been prepared to operate. In view of pathologic findings, manipulation must have a very limited application. The most striking cases were those due to primary incomplete reduction which so often resulted in a wasted quadriceps. It was advisable to explain to patients that manipulation did sometimes succeed, and contrast the procedure with that of operation. After complete reduction and re-education of the muscle, recoveries often took place. These incomplete reductions were very common, and the surgeon should not be content with his work unless the patient was able voluntarily and easily fully to extend the knee. To finish the imperfect reduction by bandaging to a back splint was a serious blunder.

The clicking knee was usually associated with insecurity of the external cartilage, and sometimes at operation it could be produced.

In one case Sir Robert was able to see it slip to and fro under the external condyle. Exploration of the joint resulted in many surprises. Every variety of injury and displacement occurred. In one case he removed the external cartilage by an incision on the inner side of the knee. It was detached from its posterior end and nestled in front of the anterior crucial ligament. The knee was locked and the symptoms had pointed to a lesion on the inner side. Stress should be laid upon the fact that the trauma induced by recurrent displacements often ended in chronic arthritis, so that, whatever the age of the patient, whenever a cartilage gave rise to pain and recurrent effusions, its removal was indicated.

Mr. R. C. Elmslie referred to the isolated lesions of the posterior half of the internal semilunar cartilage which were not easily discernible from the ordinary anterior operative approach. He had recently dealt with two cases of this type by opening the posterior synovial pouch behind the internal lateral ligament. This method he considered was worthy of more frequent adoption.

Mr. H. A. T. Fairbank said that whilst abroad during the War he had examined large groups of men collected together in a Convalescent Depot who were suffering from various traumatic affections of the knee. Many had been operated upon but showed a continued disability, a common cause of this being inefficient after-treatment. He agreed with Mr. Bristow that post-operative treatment designed to restore the power of the quadriceps was essential. In internal lateral ligament injuries he had found that the point of tenderness was usually over the femoral insertion. He had also met with undiagnosed fractures of the patella which were being treated as simple traumatic synovitis.

In operating for an internal semilunar cartilage injury, when the anterior part was found to be normal it was possible to free it by means of a fine tenotome before deciding whether the posterior part was normal or not. He was doubtful about the value of opening the joint behind the internal lateral ligament—unless this was combined with the anterior approach. If hyperextension were the cause of injury to the anterior crucial he was surprised that hyperextension was not seen with greater regularity in this class of case. He has been struck by the fact that in two or three cases he had seen it was impossible to slide the tibia forward on the femur in extension as described in the text books. Only when the joint was slightly flexed could the abnormal mobility be demonstrated.

Mr. D. McCrae Aitken supported Mr. Bristow's recommendation that a course of quadriceps muscle training should, whenever possible, precede the operation for removal of a semilunar cartilage.

With regard to the mechanism of the knee joint he did not think it had been sufficiently definitely pointed out that with the knee in slight flexion the rotation movement of the knee joint was distinct in its outer and inner portions. The rotation movement between the external tuberosity of the tibia and the external condyle was an almost pure pivot movement, while that between the long external condyle and the external tuberosity was a sliding movement. Hence when the tight internal lateral ligament put tension on the internal semilunar cartilage and this sliding movement took place under pressure, some part of the cartilage was likely to give way.

With regard to the value of X-ray photographs, while admitting their value for detecting lesions of bone, much more might be made of them in examining the semilunar cartilages themselves. In a negative of proper density in a good light the semilunar cartilages could be seen as faint wedges. In cases where the clinical evidence suggested injury of the cartilage, this definite wedge appearance might be absent or broken or blurred. If this appearance was confirmed by a second negative it was corroborative.

Mr. F. C. Pybus pointed out that injuries of the semilunar cartilage were still diagnosed on insufficient grounds, and many knee joints were opened in which no cartilage lesion could be demonstrated to an onlooker. The postero-mesial approach might allow certain lesions of the posterior horn to be displayed and treated with accuracy.

Mr. Harry Platt said that he had recently operated on three cases of early tuberculous synovitis of the knee joint in which the symptoms of internal derangement were closely mimicked. In each case the diagnosis was established by a histological examination of the synovial membrane.

An accurate pre-operative diagnosis of the nature and site of the lesion in all cases of injured internal semilunar cartilage was an ideal which all surgeons hoped to attain. In his experience he had been unable to correlate the different types of injury—as exposed at operation—with any definite combination of clinical signs. The isolated detachments or fractures of the posterior cornu of the internal cartilage were particularly interesting because they could be dealt with—as Mr. Elmslie had shown—through a postero-mesial capsular incision. Mr. Platt had used this approach in two cases after exposing from the front what appeared to be a normally attached cartilage. He believed that this posterior route was a definite addition to operative technique, and that it would be utilized more and more by members of the Association.

Mr. S. Alwyn Smith said that there were certain points raised by Mr. Bristow with which he was not in strict accord, and that there were others that, frankly speaking, he did not believe.

The first was the importance of the internal lateral ligament which Mr. Bristow appeared to consider of very secondary importance. There might be some truth in this as far as the long superficial fibres were concerned, but he could not agree that the ligament as a whole was a rudimentary structure.

He quoted from the section on the knee joint in Jones's Orthopædic Surgery of Injuries, a case of a sprain fracture of the internal lateral ligament. A heavy weight had fallen against the outer side of the patient's almost extended knee. A large plaque of the inner tuberosity of the tibia with articular surface was avulsed and the internal semilunar cartilage was found attached to it by means of an intact coronary ligament, but the cartilage was circumferentially free and loose elsewhere. Here the deep fibres of the internal lateral ligament had held, as had also its femoral attachment, which was unusual. This condition was interesting also in view of the opener's remarks as to the relationship between internal lateral ligament and internal semilunar cartilage.

Mr. Bristow's second point as to there being no relationship between lesions of the internal semilunar cartilage and anterior crucial ligament could not pass unchallenged. During the War and since, he had been struck by the number of cartilages that had been removed, where an unstable knee was also present. In a number of his crucial ligament reconstructions he had found the combined lesion of circumferential tearing of the internal meniscus and a stretched attenuated or even ruptured anterior crucial ligament.

The third point on which he wished to join issue was the dictum that "the leaving behind of the posterior half of the inner meniscus does not cause symptoms." This statement was obviously made as a suitable peg on which to hang an interesting discussion. It had been suggested by many authorities that the internal meniscus could be removed by the usual anterior incision, or at any rate as much of it as was liable to cause trouble. For some considerable time he had felt that the number of recurrences after incomplete cartilage removal were more than should have been expected even where faulty diagnosis (arthritis or sliding knee) could be excluded.

It was known to all operators that with some knees it was easy to remove the cartilage "in toto" through the anterior incision on account of a wide interarticular space, but this type of joint was the exception rather than the rule. What was one to do when on opening the joint one was unable to see any obvious lesion? He supposed that we all salved our consciences by mentally noting the mobility of the anterior portion and proceeded to divide it circumferentially and from its anterior attachment, hoping that with gentle traction and further marginal dissection the suspected tear would manifest itself by the jumping forward of the cartilage. Division of the posterior attachment as far back as possible completed the work. In many such cases Mr. Alwyn Smith was sure that the cartilage was not circumferentially divided far enough back, and by heavy traction with forceps a portion of the free border of the cartilage was snipped off, leaving as likely as not a large mass behind which conceivably might be the cause of future disability. For some time it had been his custom in all cases where no obvious lesion was found through the anterior incision, to make a postero-internal incision in addition, so that the back part of the cartilage could be directly inspected and dealt with. He also used the combined incision in cases where on account of limited interarticular space circumferential dissection beyond the coronary ligament was found to be difficult.

By this method the internal lateral ligament is not interfered with;

this he considered important, as unlike Mr. Bristow he had a profound respect for its integrity.

Mr. Alwyn Smith then showed diagrams of three cartilages which he had removed by the combined route within the last three months. In the first the only lesion was a circumferential tear of the posterior quarter of the meniscus; in this apparently the original tear was of greater extent, but incomplete healing had occurred. The symptoms were those of recurrent effusion, limited in extent, and a feeling of insecurity without locking. The second one showed a transverse fracture at the middle of the cartilage with finger-like maceration of each of the fractured ends, the result of repeated injuries. When the anterior half was removed, it was not possible to grasp the posterior part with forceps, so it was removed by the supplemental incision. The third case was one where an original "bucket handle" had partially healed—both anterior and posterior horns were loosened and in addition there was a long "ear" caused by a partial tear of the free margin—this lay posteriorly in the intercondyloid notch. He ventured to say that in none of these cases could the cartilage have been satisfactorily removed by the anterior route, as in each instance the interarticular space was small, and he suggested that in none would the removal of the anterior half have remedied the symptoms.

The anterior incision was made in the ordinary way with the knee fully flexed in the usual position, and where no definite lesion was found the cartilage was divided at its anterior attachment and also circumferentially as far back as possible. If gentle traction of the meniscus did not permit its delivery into the wound (showing that it was free except for the attachment in front of the posterior crucial ligament) the supplemental incision was decided on. The table flap was now elevated until it made an angle of 30° with the rest of the table and the leg was rotated outwards at the hip and flexed to 45° at the knee,—the tailor position. A two-inch incision was made over the postero-internal surface of the joint in front of the sartorius, its midpoint being above the joint level. The long saphenous nerve was seen and retracted backwards, and also the tendon of the sartorius. The joint was opened by means of a vertical stab wound and the synovial membrane is seen to be pouting and relaxed. The posterior part of the cartilage was then in full view and any abnormalities could be noted. Circumferential dissection was completed until the point of section reacted.

The cartilage could now be delivered through the posterior wound and its posterior attachment divided under direct vision with no risk of damaging the crucial ligaments. The time of operation was prolonged but little,

and in no case had the convalescence been interfered with in any way.

Mr. Max Page referred to the opener's criticisms on the paper on the subject under discussion published in the British Journal of Surgery by Mr. Mitchiner. He felt that it was only just to the author of this paper to point out that it was a statistical compilation made when he occupied the position of Surgical Registrar to St. Thomas's Hospital. He felt that whatever value the article might have as a record of the late results of these cases, the conclusions drawn from them were not comparable to those which might be formed from a personal series.

In regard to the treatment of definite cartilage injuries, he differed from the opener's view as to the value of pre-operative preparation. He did not think that any prolonged physio-therapeutic treatment in the presence of a definite cartilage injury was worth carrying out. In his opinion it was better first to rectify the joint condition and to concentrate subsequently on the full restoration of function.

In relation to the operative treatment of cartilage injury he did not think a tourniquet was always necessary, and he considered that its use had certain definite drawbacks. In his experience in straightforward cases when the lesion was clearly localized, a perfectly satisfactory view of the operation area was obtained without the tourniquet, and the subsequent effusion in the joint and post-operative pain were less than in those in which it had been used. He was also convinced that the use of a tourniquet for more than a very short time prejudiced the resistance of the joint to any infection which might be present, and suggested that the instrument was a good servant but a bad master.

Commenting on Mr. Alwyn Smith's advocacy of the posterior approach to the internal cartilage, he said that he felt that, though the incision was sound anatomically, a large proportion of cases of damage to the posterior section of the cartilage could be dealt with through the usual anterior incision, and he felt that the double incision should be adopted only in exceptional cases.

Mr. Robert Ollerenshaw said that there were several points on which he should like to offer comment. Firstly, as to the value of radiograms in differential diagnosis. The opener, and several other speakers, had described unsuspected fractures of the tibial spine and upper articular surface of tibia revealed only by radiograms. In younger subjects, following knee injuries, the speaker had on three occasions found fractures of the lower edge of the patella. In his experience this type of patellar fracture quite frequently occurred with so-called "Schlatter's disease." In one patient where both knees were injured he had found a patellar

fracture of this variety on the right side, and a typical "Schlatter" on the left.

He agreed with Mr. Bristow as to the importance of pre-operative treatment of the thigh muscles. Mr. Dunn asked about the late condition of the cases operated on for reconstruction of the ruptured anterior crucial. He had done a number of these operations and had recently examined one of his cases operated on three years ago. In this man the instability of the knee before operation was extremely marked. The tibia could be pushed forward on the femur both actively and passively for about an inch, and the internal lateral ligament was also very poor. The man complained that the knee frequently "let him down" whilst walking. The result of the reconstruction operation had been extremely good. The man was doing heavy work and there was very little abnormal play in the joint even to strong traction.

Mr. Paul B. Roth did not agree that the muscles were more important than the ligaments of the knee joint. Mr. Bristow had obviously forgotten the cases of anterior crucial ligament rupture produced with the knee in the position of right angle flexion, the tibia being driven backwards by direct violence. This type of injury was not uncommonly seen in persons involved in railway collisions. Injuries of the internal semilunar cartilage could almost always be diagnosed on the history alone, but a radiogram was essential if mistakes were to be avoided. In operating he used as a routine the vertical split-patellar route which gave an unlimited view.

Mr. T. R. W. Armour, in discussing the mechanism of the production of internal semilunar cartilage injuries, drew attention to a type of case in which the initial displacement occurred as the patient rose from the kneeling position. This mechanism was often seen in men engaged in carpet laying, an occupation which had provided a considerable number of hospital patients on whom Mr. Armour had operated. He believed that the average semilunar cartilage injury was essentially a fracture.

Mr. S. T. Irwin discussed briefly the mechanism of production of displacement of the cartilage and expressed the opinion that none of the theories already propounded were altogether satisfactory. He considered that the first necessity for rupture of the cartilage was displacement inwards, the cartilage then being caught and held by its free edge. Mr. Malcolm had advanced the theory that this displacement was due to atmospheric pressure, that when the joint was abducted a partial vacuum took place in the interior of the joint and that the soft tissues yielded at the most pliable point, namely, the anterior part of the cartilage. If this

were true and if rotation of the tibia on the femur followed, one would be justified in assuming that the free edge of the cartilage would be held, and a tear or fracture would somewhere occur. It was hard to believe that the mechanism of displacements of the posterior end were identical with those at the anterior end or with a displacement of the complete or bucket handle type. The speaker was of the opinion that bucket handle displacements were rarely produced by a single accident, but were liable to occur in cases in which either the anterior or posterior part had already been displaced, and he thought that the variation between the anterior and posterior was due to the position of the joint at the time of displacement.

In regard to ruptures of the anterior crucial ligament, Mr. Irwin mentioned two cases which he had operated upon. Both of these cases were produced in the same way, in Association footballers who, attempting to "drop" a ball, slipped over it with the leg in full extension at the knee. This would seem to indicate that at all events it is possible to rupture the anterior crucial ligament in full extension. In regard to the development of arthritis in those joints in which a cartilage had for many years been displaced, Mr. Irwin instanced a case of a surgeon who, twenty-four years ago, suffered from displacement of the cartilage in playing football. This man now showed a considerable amount of osteo-arthritis, with coarse grating and some limitation of movement. If, therefore, this condition could have been prevented by a timely removal of the displaced semilunar cartilage it would supply another argument for operation, in addition to the fact that operations in real displacements of the cartilage give such satisfactory results from the immediate point of view.

Mr. Bristow in closing the discussion said he would like to make two points quite clear:

(1) That without writing a text-book on the knee as a preliminary introduction to this subject, it was quite impossible to introduce it without many omissions, and he was aware of the fact that many points in connection with internal derangement were not incorporated in his opening paper.

(2) That he had purposely unduly stressed certain points in order to stimulate discussion. Perhaps the most contentious of these was the function of the internal lateral ligament. In order to focus attention on this structure, he had rather understated its importance.

He felt that at the present time he found it impossible to estimate exactly the degree of damage in a torn cartilage or the site of damage in the cartilage from a consideration of the symptons; and further, that the

more interest one took in this subject, the more difficult did the differential diagnosis become!

It was necessary in any opening paper to make statements which were more or less dogmatic; but for his part, as his experience increased he was less and less inclined to dogmatize.

He did not propose to discuss in detail the various criticisms, but there were a few on which he would wish to comment.

The President had stated that he had met with true hypermobility of the cartilage. Mr. Bristow agreed that in expert hands this diagnosis was permissible, whilst holding the view that it was excessively rare, and that many cartilages were removed which were said to be hypermobile when their attachments were quite normal. He agreed with Mr. Armour that practically all detached cartilages were also fractured.

In conclusion, he thought that the incision for exploration of the back of the joint, as advocated by Mr. Alwyn Smith, Mr. Elmslie, Mr. Platt, and others, was a distinct advance. He had used this incision for the removal of loose bodies and had been impressed by the ease with which one could explore the back of the knee.

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COMPLETE PARALYSIS OF THE ANTERIOR CRURAL NERVE FOLLOWING CHILDBIRTH

BY N. AUSTIN CARY, M.D., OAKLAND, CALIFORNIA

Mrs. J., age twenty-six, American, of strong athletic build, mother of two children, developed a complete loss of function of all muscles supplied by the anterior crural nerve, following the normal birth of her second child.

Her first pregnancy occurred a few months after marriage. Progress with the first pregnancy was normal throughout, until the eighth month, when a dull aching developed in the symphysis pubis and low back. Pain gradually replaced the aching, growing progressively more severe until delivery, which was normal under gas. Following delivery the low back pain persisted, the symphysis symptoms disappearing in a few days. Complete relief from pain and aching in the low back was not obtained until four months after delivery.

There was no definite history of loss of power in either leg following this birth. The patient remained well and free from symptoms until the seventh month of her second pregnancy, which occurred two years after the first. Here again progress was normal until the seventh month, when the dull aching in the symphysis and low back returned. The symphysis aching developed rapidly into dull pain, increasing with movement and making locomotion extremely unpleasant. Rest in bed gave the greatest amount of relief. Support of the pelvis was impossible, due to soft tissue sensitiveness over the upper portion of the symphysis pubis and extending outwards along the course of Poupart's ligament on the left side. The pain in the low back continued, but was bearable.

There were no bladder or bowel symptoms present. Locomotion was possible, but refrained from because of the discomfort resulting. Any attempt to walk resulted in a clumsy gait, which she explained was due to the pain produced in the symphysis, remarking also that her left foot felt as if it did not belong to her. The usual supportive measures instituted for the support of her pelvis gave but slight relief from pain in the symphysis.

Delivery occurred at full term (normal under gas). No relief was obtained from the symphysis pain after delivery, so for the first few days all attention was directed to this persistent and annoying symptom.

Extreme tenderness and swelling had developed over the articulation, the symptom being localized from the center of Poupart's ligament on both sides, with greatest discomfort directly over the articulation.

On the fifth day a loss of power was noted in the left leg. About four weeks after delivery her attending obstetrician requested consultation, because of the continued and annoying pain in the symphysis pubis and the loss of function in the thigh and leg muscles. Her general physical examination was objectively negative; she was lying quietly in bed upon her back, the limbs completely extended. This position, she stated, gave her the greatest degree of comfort, while any attempt at movement produced pain in the symphysis. There were no symptoms referable to the back.

She had been up from her bed attempting to walk after her second week, and had endured the pain in the symphysis, feeling assured it would disappear as had her backache from her previous birth. Movement of the left limb, however, was impossible. She felt sure the symphysis pain and soreness was not improving.

On pressure over the symphysis articulation she complained very severely of pain, while slight tenderness was found to result on pressure over both sacro-iliac joints. There was no tenderness discernible along the sacral nerve trunks.

Voluntary flexion of the thigh upon the trunk and the leg upon the thigh was lost. All foot and ankle movements were normal. Abduction and adduction of the thigh was slow and unsteady, producing pain in the symphysis. Tactile and heat sensations were normal throughout the leg and foot. The patellar knee jerk was greatly diminished in the left side, but remained normal on the right. Electric testing of muscles was not made.

X-ray examination showed no abnormalities of the bony pelvis or its articulations.

PROGRESS

Because of the severe pain in the symphysis incident to movement, she was advised to remain in bed. A corset belt was constructed of corset cloth to hold the pelvis snugly fixed. This gave some relief. Absolute rest with the knees slightly flexed over an improvised support was provided. There was no pain or soreness in the muscles of the affected limb. To stimulate return of function, the patient was taught to contract the muscles of the unaffected limb without movement. Three times a day for a short period the nurse supervised attempts at muscle contractions in both limbs, preceded by gentle massage and friction of the affected limb. Two weeks

after her delivery we could see slight evidence of returning function in the sartorius and pectineus muscles. One week later slight contraction of the thigh muscles could be made, but not sufficient to lift the limb from the bed. This movement, we believed, was principally due to the action of the tensor femoris fascia muscle, stabilized by the sartorius and pectineus. Beginning with the eighth week after delivery there was a fair return of function in all the muscles of the thigh, but power of flexing the leg upon the thigh with the patient prone was very slight. Pain in the symphysis was present, but greatly reduced.

Nine weeks after delivery the leg could be flexed upon the thigh. The tone was very poor in all muscles, but gradually improved. Massage and muscle contracting were continued with complete rest between periods. Soreness or pain never developed in the muscles of the affected limb. Patellar reflexes were stronger.

Twelve weeks after delivery the pain in the symphysis had subsided sufficiently to permit the patient to be up in a chair. Attempts at walking were permitted, but advancing of the left foot was slow and labored. She soon learned that by walking backwards she could make better progress, which manner of locomotion she quite readily adopted. Massage and muscle training were continued twice daily.

Fourteen weeks showed a complete return of all muscle movements, but the pain and soreness in the symphysis continued and had a depressing influence upon the patient's progress. Tone and strength were gradually returning to the muscles; selective movements were slow and difficult; support of the body weight upon the affected limb was possible; but any raising of the body weight with the affected limb could not be accomplished.

Because of the persistent pain in the symphysis, ankylosis of this articulation was suggested by others in attendance. In this I could not concur, believing that the pain would eventually disappear without operation. Four and one-half months after delivery the pain had subsided, except on sudden twisting of the pelvis. No complaint was reported six months after.

Complete return of function and normal strength was present in the affected limb six months following delivery.

COMMENTS

This was the second patient with a complete paralysis of the entire anterior crural nerve following childbirth to come under my observation in nine years. With the first patient the duration of the paralysis was

about half of that observed in the second case. The manner and time of onset of the associate symptom, pain in the symphysis pubis, was about the same.

Permanent paralysis of the peroneal nerve as a complication of labor had been observed by me, and the persistence of the paralysis in this last patient was sufficient to warrant considerable worry as to the ultimate outcome. The persistence of the associate symptom that had come on before delivery had given occasion for additional worry, as these had afterward failed to subside.

Our present experience, however, forces us to classify the lesion as a temporary total paralysis of the entire distribution of the nerve, as the patients observed were subjected to no demonstrable permanent disability. Mild transient types of paralysis of this nerve most certainly occur and are overlooked, their presence being considered a post-delivery incidence rather than a complication, disappearing from within a few hours to within a few days.

There is no reference, as far as I am able to find, to a paralysis of the anterior crural following childbirth. Standard text books and periodicals devoted to obstetrics, neurology, and orthopædic surgery fail to refer to the lesion as a post-delivery complication.

In the two protracted cases which form the basis of this report there was present, as a pre-delivery symptom, pain in the symphysis pubis coming on six and eight weeks respectively. Associated with this pain was a dull aching in the low back accompanied by marked tenderness on pressure over the symphysis pubis and, to a much less degree, over the upper border of the sacro-iliac articulations, unrelieved by any form of treatment (except opiates). The dull aching grew progressively more severe and unrelievable after delivery.

Preceding delivery for a period of two to three weeks there was reported a clumsy locomotion, with difficulty in controlling the affected leg. The left leg was the one affected in both patients, but a pre-delivery paralysis was not present. Locomotion was difficult because of the marked increase in symphysis pain incident to movement, recumbency being preferred.

Both patients were multiparae and gave a history of normal delivery under gas at previous births of one child each, with a post-delivery backache that persisted for many weeks, gradually subsiding.

The case of the first patient observed was classified as a post-delivery incidence rather than as a complication, so far as the paralysis was con-

cerned. The persistent agonizing pain in the symphysis chiefly occupied our attention, failure to move the limb being due to her fear of stimulating the pain. Reviewing her case history, I find the limb could not be moved for three weeks, and complete restoration was not established until the twelfth week. The pre-delivery symptoms began six weeks previous. The second patient required twenty-four weeks for complete recovery, and the pre-delivery symptoms developed eight weeks before. Both experienced the same severe, persistent pain in the symphysis pubis that was never completely relieved by any of the usual methods of treatment, but obtained the greatest degree of relief by recumbency.

The obstetrician's findings in the case reported are as follows:

From the obstetrical standpoint there was nothing of note in the early and the personal history of this patient. As mentioned above there was difficulty experienced during the last month of her first pregnancy and for two months post partum. The physical examination, including pelvic measurements and laboratory findings, was entirely negative. The pelvis was very roomy, with some relaxation of the general pelvic supporting structures, and the abdominal wall also showed loss of tone. So marked were these factors that the gravid uterus sagged deeply into the pelvis, and as early as the seventh month began to cause pressure discomfort in the pelvis and its joints. Every effort was made to secure relief with corsets and firm support, but these were inefficient and proved extremely uncomfortable. So great was her discomfort that it was necessary to restrict her activities very materially during the last month of pregnancy and she was advised to spend much of her time reclining. Attempts to induce labor with castor oil, quinine, and small doses of pituitrin were unsuccessful and she went to term to be delivered under gas anesthesia after a short labor. The post partum progress has been summarized. The full development of the paralysis was very slow and was not detected until some days after delivery.

Pains in the pelvic joints so prevalent during pregnancy we feel are due to a combination of pressure and the extreme congestion coincident with pregnancy, as a result of which the joint supports become relaxed and permit of unusual motility, with resultant strain and irritation. Nerve irritation, whether inflammatory or from pressure, is usually secondary. In the case under consideration there was undoubtedly joint irritation and congestion with inflammatory change and pull on ligaments, but it seems that the unusual symptoms and the clinical findings can be accounted for only on the basis of the anterior crural nerve having an anomalous course which subjected it to pressure by the low lying fetal head.

DISCUSSION

The anterior crural nerve, if in normal position, should lie free from pressure and injury during a pregnancy and delivery. It is the largest nerve in the lumbar plexus, arising from the second, third, and fourth lumbar nerves. It runs through the psoas muscles which it supplies, then out into a depression between the psoas and iliacus muscles, covered only by the iliac fascia, dividing into two branches, the anterior and posterior.

The anterior portion provides the muscular branches to the pectineus and sartorius. The posterior branches supply all the muscles of the anterior portion of the thigh except the sartorius, which is supplied in part by the middle cutaneous and the tensor fasciae femoris muscle, being supplied principally by the superior gluteal (Deaver).

Our observations in the cases cited showed upon primary examination a paralysis of all muscles supplied by the anterior crural nerve.

The symphysis pain is probably due to two causes: first—irritation of the genital branch of the genito crural nerve. This nerve originates almost exclusively in the second lumbar root. It makes its way forward across the fibers of the psoas, emerges on the anterior surface of this muscle, and then descends parallel to the latter right to the anterior inferior iliac spine, where it divides.

Lesions of the genito crural nerve show themselves for the most part in sensory disturbances, painful hyperaesthesia being generally observed the result of irritation of the nerve. Congenital mal-position of these nerves with pressure from the gravid uterus is possible. Second—in the two cases observed, the fetus has occupied an unusually low position in the pelvis—constant pressure upon the pelvic frame has widened the symphysis articulation, placing the supporting structures of the articulations on tension, with resulting irritation and inflammatory changes.

CONCLUSIONS

1. Pseudo or temporary paralysis of the anterior crural occurs, complicating pregnancy.

2. The paralysis appears to be due to pressure upon the nerve before it divides into the anterior and posterior branches, as manifested by paralysis of the entire motor distribution. (There was no disturbance in sensation.)

3. The occurrence, we believe, is probably incident to an abnormal position of the nerve in its pelvic relations.

4. Age and physical conditions did not appear to enter into the etiol-

ogy. Both patients were well nourished and developed, the younger being twenty-six, the elder thirty-nine.

5. No permanent disability was observed. The duration of the paralysis may be from a few hours to several months.

6. Mild transient types of cases most certainly occur, their presence being overlooked or considered a post-delivery incidence rather than a complication of labor.

7. Cases may be divided into pseudo partial and pseudo total, depending upon the point of pressure.

8. Primary separation of the symphysis articulation occurs, permitting the head to occupy a position low in the pelvis.

9. The severe pain in the symphysis pubis is due to two things: first—early separation of the symphysis articulation, resulting in an inflammatory lesion of the normal synovia; second—irritation of the sensory portion of the genito crural nerve from pressure.

CENTRAL FRACTURE OF THE ACETABULUM

With a Report of a Case

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Before the advent of roentgenologic diagnosis, fracture of the acetabulum was believed to occur either very seldom or only as a complication of a backward dislocation of the pelvis. Following the routine examination of all fracture cases by means of the X-rays, it has been demonstrated that isolated fractures of the acetabulum are not of rare occurrence. In a recent article, Kleinberg[1] states that up to 1912 Vaughan[2] was able to collect only twenty-six undoubted cases, and since then Peet has reported one case and reviewed fourteen others described by various authors. Whitman[3] reported a case and mentioned having seen five others in his orthopaedic practice. As Kleinberg states, there are two distinct types of fracture: one in which the femoral head is not displaced in the pelvis, and the other in which there is a central displacement of the femoral head.

The case about to be reported belongs to the second group, which is more rare and is brought about by a force acting on the trochanter, splitting the acetabulum, and allowing the head of the femur to enter the pelvis. The diagnosis is made from the symptoms of pain on pressure over the great trochanter, varying degree of limitation of voluntary motion at the hip in all directions, absence of evidence of fracture of the neck of the femur, palpation of the femoral head per rectum, flattening of the trochanter, which is more marked than in an impacted fracture of the neck of the femur, and absence of eversion of the limb. The most important evidence is, of course, the positive findings on radiographic examination.

Treatment. In Keen's Surgery, Vol. II, p. 239, Eisendrath states that the most satisfactory method of treatment is combined longitudinal and lateral traction. Since the advent of the Balkan frame or traction suspension technique this form of treatment has been used in several cases to my knowledge with good result. Kleinberg states that in most of these fractures of the acetabulum, intrapelvic displacement of the femoral head cannot be treated because of the inaccessibility of the parts. In two of three cases which he reports, however, treatment resulted in

excellent functional result, and while the fragments themselves are usually inaccessible, proper reduction of the central dislocation generally allows the fragments to fall into alignment so that union takes place, and the functional result is apt to be quite satisfactory. The general condition of the patient is in many cases grave, owing to the fact that these fractures are often accompanied by injury of the pelvic organs and fracture of other portions of the pelvic ring. Where such complications do not exist, treatment can be directed at once to the reduction of the dislocation. On the other hand, in many cases the general condition of the patient and the complicating injuries, such as severe shock or extensive involvement of pelvic organs, demand first consideration, and the fracture is an entirely secondary consideration. Thus treatment may have to be postponed for weeks or even months. One of Kleinberg's patients received no treatment except baking and massage for five months following injury. The abduction method, popularized by Whitman and used extensively for fractures of the neck of the femur, has been recommended and used by him for fractures of the acetabulum, and was the procedure adopted by Kleinberg in his three cases. This method was used in the case to be reported, and, judging from the results here obtained, it would seem to be entirely satisfactory in this type of fracture.

CASE REPORT

A. McG.; male; 55 years old; in good general health.

Past History. Pneumonia at 20 years of age; lues at forty.

Present Illness. On April 21, 1923, patient was struck on the right side by a taxicab, and thrown to the pavement, falling on his left hip. Pain in the left hip was the first symptom. He was removed to the hospital in an ambulance, and before any treatment was begun, he was transferred two days later to the Hospital for Ruptured and Crippled. Measurements showed very little shortening (one-half inch) and no eversion or other gross deformity. Motion at the hip in any direction caused pain. Rectal examination failed to reveal evidence of the head displaced into the pelvis. If the patient remained quietly in a supine position, the pain was not severe. Radiographic examination on admission showed a comminuted fracture of the acetabulum with displacement of the femoral head internally; also a fracture of the inferior ramus of the pubis with very little displacement. (Fig. 1.)

Treatment. The patient was given a general anaesthetic, drop ether, and when relaxed, traction was made on the affected side, combined with

wide abduction, with the purpose of levering the hip out of the pelvis, using the great trochanter as a fulcrum against the upper rim of the acetabulum. The patient was then encased in a plaster spica with left leg widely abducted. A roentgenogram was made as soon as the cast had hardened, and the position seen to be satisfactory. On studying the picture, it was seen that the femoral head had been withdrawn a distance of one to one and a half inches from its position after the accident. Five

FIG. 1

Roentgenogram showing fracture of left acetabulum with central luxation of femoral head; there is also fracture of left descending pubic ramus.

weeks after the injury the cast was removed from the foot up to just above the knee, and active and passive movements, massage, and heat were applied. The knee and ankle joints very rapidly recovered full range of motion. Eight weeks after the injury the entire cast was removed and gentle motion, passive at first and then active, was instituted. The muscles of the thigh, which showed some atrophy of disuse, were daily massaged. The patient was in a wheel-chair at nine weeks, and was walking with crutches four months after admittance. At this time there

was only a slight limp, and range of motion at the hip was practically normal in all directions, as shown by the photographs—Figs. 3-6.

Fig. 2 shows roentgenogram taken four months after injury.

Examination seven months after the injury: Patient states he has no pain; he walks without an appreciable limp, has full range of motion at the hip, and is now able to ride a bicycle without discomfort.

FIG. 2

End result four months later showing restoration of acetabulum, reduction of femoral displacement, and union at site of fracture of pubic ramus.

SUMMARY

The principal points to be emphasized are as follows:

1. The importance of an early diagnosis, in making which, one should be guided by the history of a blow over the great trochanter, tenderness and disability of the hip-joint, and, most important of all, an early roentgenogram which will render the diagnosis certain.

2. The value of the Whitman abduction method of treatment of

these fractures, by means of which the central luxation of the head of the femur is reduced, owing to the strong leverage which can be applied to the femur in such a manner as to cause the head to be withdrawn from the

FIG. 3

Result four months after injury; erect posture shows no deformity and no shortening.

FIG. 4

Abduction to forty-five degrees.

pelvis, the impingement of the great trochanter on the superior rim of the acetabulum acting as a fulcrum.

3. Early mobilization of the ankle and knee joint, together with

massage, followed by gentle passive motion of the hip, and later active motion and weight-bearing, which may be allowed at three months. The

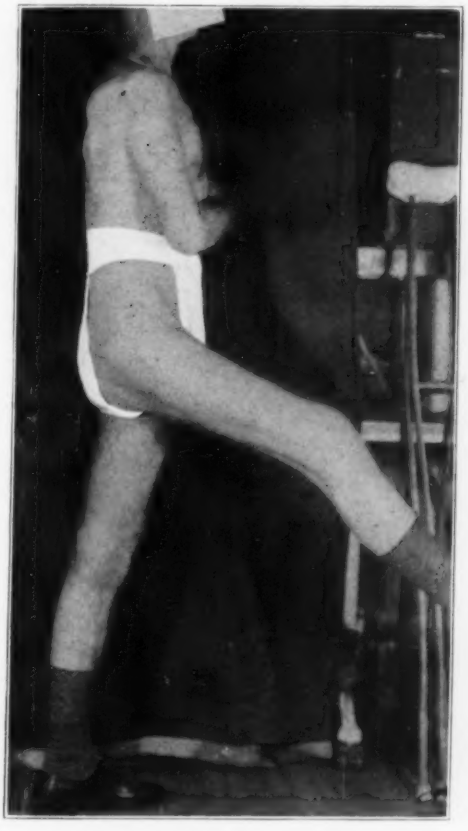

FIG. 5

Flexion to eighty degrees.

FIG. 6

Internal rotation.

use of the walking machine is helpful in the early stages of weight-bearing, and crutches for several weeks thereafter. Restoration of the continuity of the acetabulum, as in the case here reported, may be remarkably complete.

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OSTEOCHONDRITIS DISSECANS OF THE KNEE

BY IRVIN BALENSWEIG, B.S., M.D.

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In an article on Loose Bodies arising from the Articular Surface of Joints, appearing in the *Journal of Bone and Joint Surgery*, April, 1924, Phemister states that "the body comes from a lateral surface of the medial condyle in a great majority of cases. The patella is occasionally the source, but bodies arising from the external condyle or from the tibia are extremely rare." The following case report concerns a loose body arising from the external femoral condyle.

CASE REPORT

A. P., male, age 20, clerk by occupation, was first seen on February 5, 1924, complaining of pain and disability of the right knee; duration three weeks. At that time, while playing basketball, he stopped suddenly, this resulting in a rotation and flexion of the knee. He was unable to extend the joint and had to be assisted off the field. The affected joint became swollen and remained in a semi-flexed attitude, making walking both painful and difficult. Some three years ago, while sliding towards first base, the same joint was injured and remained swollen and painful for a period of about a week. At that time, however, there was no locking of the joint.

Examination. Patient walks with a right-knee limp, with the joint partially flexed and the foot in an attitude of equinus. There is atrophy of the lower thigh on the medial aspect, and some swelling of the knee, but no discoloration. The angle of greatest extension is 160 degrees, and the angle of greatest flexion is 140 degrees. The joint can be passively flexed to within normal limits, this being accompanied by an audible click and pain on the outer aspect. There is some swelling in the region of the external semilunar cartilage, accompanied by tenderness to touch and a feeling of crepitation on palpation. The right knee measures 35 cms. above the patella, 35 cms. over mid-patellar region, and 31 cms. below the patella.

The corresponding measurements of the left knee are, 37 cms., 34 cms., and 31 cms.

The clinical diagnosis of dislocation of the external semilunar cartilage of the right knee was made, and roentgenograms ordered, which revealed the presence of the following:

In the antero-posterior view, a widening of the interarticular space of the lateral region, with an increase in density; the lateral view presents an oval shadow, 1 cm. in its greatest diameter, situated in the posterior inferior aspect of the external condyle of the femur, and separated from it. There is a corresponding depression in the condyle.

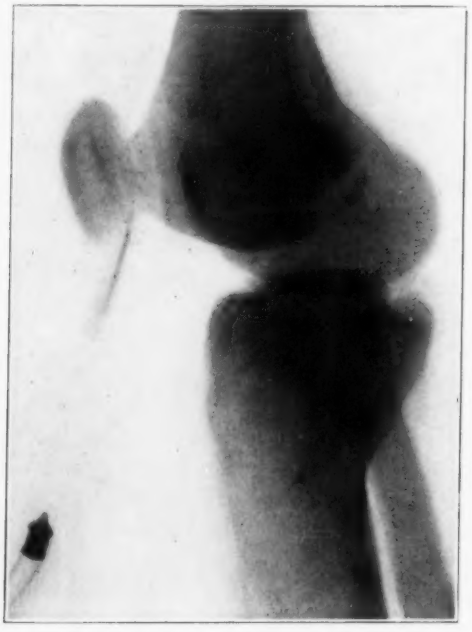

FIG. 1

Roentgenogram showing loose body in the lateral view.

Roentgenograms taken following oxygen injection into the affected joint reveal nothing new, but bring out the above more clearly. The condition is unilateral.

On February 11th an S-shaped incision about six inches in length was made on the outer aspect of the knee, and the capsule incised over the mid-

portion of the semilunar cartilage. An excellent exposure was obtained by carrying the capsular incision up between the vastus lateralis and the quadriceps tendon. Exploration of the joint showed no evidence of synovial thickening, but revealed a detached and very much thickened semilunar cartilage. The lateral meniscus was then excised. On acute flexion of the joint the postero-lateral compartment was exposed, disclosing a loose body separated from the condyle by about an eighth of an inch. A fringe of condylar cartilage overhung the body, which was found to extend across

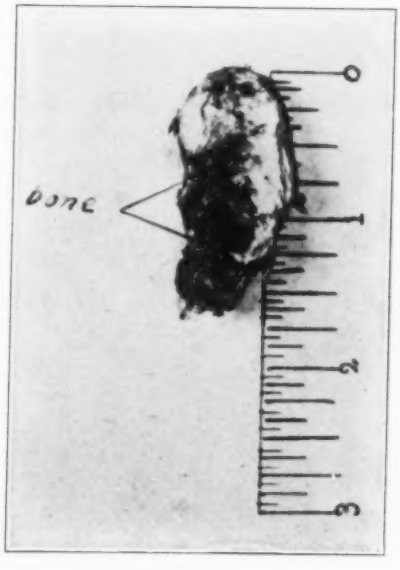

FIG. 2

Actual size photograph of superior surface of specimen.

the entire width of the condyle, and attached by a fibrous pedicle to the lateral aspect of the intercondylar notch. Its removal was accomplished with a fair degree of difficulty. Inspection of the condyle showed a depression about the same size as the removed portion, but not quite the thickness of the latter, and lined with fibrous tissue. There was no evidence of bleeding from the exposed surface. The joint was irrigated with saline and closed in layers, using zero chromic catgut for the synovia and capsule, No. 1 chromic catgut approximating the vastus externus and quadriceps

tendon, plain catgut for the subcutaneous tissues, and silk for the skin. Dry dressing applied, and patient returned to ward in good condition.

Pathology. The gross specimen is an oval shaped cartilaginous body measuring one and seven-eighths inches in its longest diameter, and five-eighths of an inch in width; its greatest thickness is three-eighths inch. The medial pole consists of fibrous tissue, and partly imbedded in its proximo-medial aspect is an oval mass of bone, its free surface being smooth and covered by fibrous tissue. The posterior border presents a fringe of cartilaginous material.

Microscopically, there is no evidence of infection nor of necrosis; neither can it be said that there is any evidence of new bone formation.

Etiology. Of the various theories suggested relative to the cause of loose bodies of this nature, the most likely one is that of an osteochondral fracture of the external femoral condyle as a result of cross strain, aided by the pull of the anterior crucial ligament.

Recovery has been uneventful, and patient at the present time (July, 1924) has regained complete range of motion of the affected joint, and suffers no discomfort.

MULTIPLE ENCHONDROMATA OF SCAPULA.* REPORT OF A CASE

BY H. H. WESCOTT, M.D., ROANOKE, VA.

The following case is reported because of the unusual and remarkable size of the tumor removed and the multiplicity of lesions.

History. D. F. N., a man aged 24; laborer; complaining of pain in right chest and arm for three months, exaggerated on lifting arm, on deep breathing, and on lying on right shoulder.

Family history. Father dead, accident; mother living and well; one brother born with club feet; three brothers dead, cause and age unknown. No history of malignancy, insanity, or epilepsy in family. Canadian by birth. Served in U. S. Army between his sixteenth and nineteenth years. Had influenza in 1918 and Neisser infection six months ago. Indefinite history of injury to right shoulder as a child; otherwise negative. When eight years of age, noticed that the right shoulder was broader than the left; had not noticed any bony prominence or swelling elsewhere, and suffered no discomfort except as noted above, even though doing arduous work.

Examination. Fairly well developed and normal male adult. Acne on back. Chest, moderate pigeon breast type. At the middle and lower portion of the anterior surface of the right scapula there was a hard, smooth, cylindrical mass projecting anteriorally and medially, which could be felt in the posterior axillary fold, about 2.5 cm. in diameter and 7 cm. in length, and apparently pressing on the posterior surface of the fourth and fifth ribs. The tumor was solidly fixed to the anterior surface of the scapula, and moved as one piece with it. No tenderness or redness over the tumor mass. No limitation of movement of shoulder or arm. Any motion of the scapula produced a referred pain down the right arm medially and over the lateral surface of the right axilla. There were numerous similar hard, smooth outgrowths from other bones. From the upper and middle thirds of both right and left humeri, small hard masses about 1 cm. in diameter projected. These were sharply circumscribed. Somewhat smaller ones were present on the medial aspect of both tibiae almost opposite the tibial tubercles. There was another on the middle phalanx of the third finger, left hand.

* From the Orthopaedic Service, Massachusetts General Hospital, Boston, Mass.

Roentgen-ray report. Sharp slender bony prominence from the external aspect of the humerus about four or five cm. below the neck, and seen through the scapula in the antero-posterior view an irregular appearance of increased density in the lower portion of the body of the bone, suggesting possible similar bony tumor in this region.

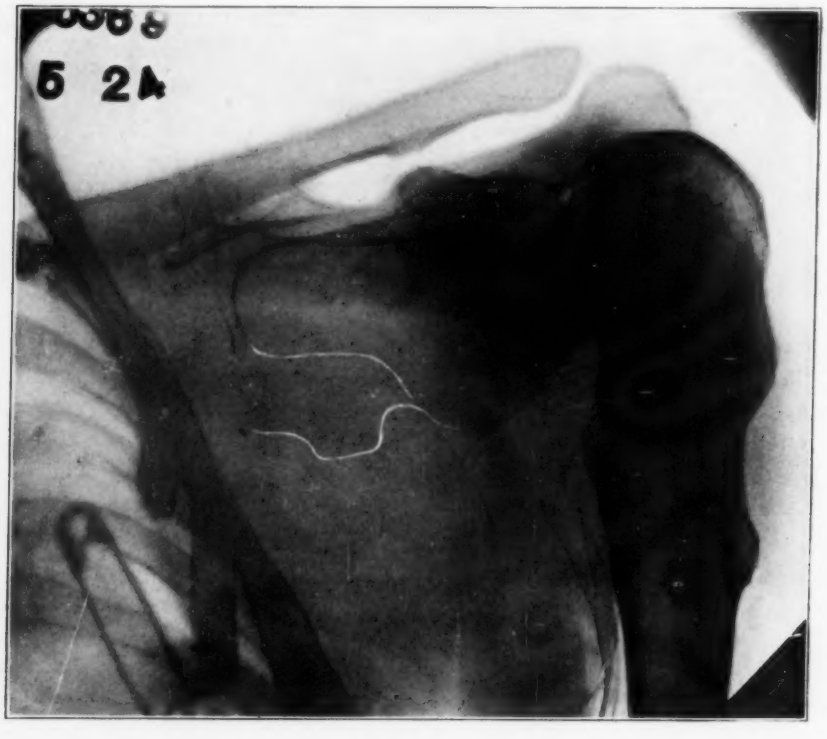

FIG. 1

Plates taken of both knees show similar bony growths near the junction of the epiphyseal line. These growths have the structure of normal bone except at the ends, where they tend to have a cauliflower-like appearance.

Also changes about the upper end of the femur.

Multiple cartilaginous exostoses. Scapula shows spur formation.

Operation. Under gas oxygen anaesthesia, an incision was made over axillary border of scapula, extending in a straight line from neck to in-

ferior angle, through skin, soft parts, and periosteum. With periosteal elevator, periosteum was lifted on posterior surface upward to within one inch of spine. Two small exostoses were found on the vertebral border from which the periosteum was freed. The scapula was lifted by a hook, and dissection carried forward round the axillary border to the anterior

FIG. 2

surface, where a large exostosis was revealed near the margin, 2.5 cm. in diameter. Slightly above and to the inner side a larger exostosis was found 7 cm. in length and curved on itself, pressing against the fourth and fifth ribs, and with a cartilaginous end surface. The mass was smooth and about 2.5 cm. in diameter. The vertebral border of the scapula was

cut by biting forceps, and the axillary border just below the neck by an osteotome. The infraspinous portion of the scapula to within 2.5 cm. of the spine, and parallel to it, was removed. Cavities left by removal of exostoses were closed with c.c.g., with rubber drain in deeper cavity. Superficial sutures of c.g. and skin sutures of silk. Chest swathe applied and arm bandaged in sling. To the ward in good condition.

FIG. 3

Post-operative course. Wound dressed twenty-four hours after operation. Rubber drain removed. Patient had uneventful recovery. Normal temperature. Stitches removed on ninth day.

Patient left hospital on tenth day.

Twenty days after operation, abduction of 45 degrees; rotation slightly limited internally. Thirty-one days after operation, all movements normal without pain or discomfort in region of shoulder or back.

Pathologic report. A portion of the scapula showing a long, bony protuberance on one surface extending upward for a distance of 7 cm. It has a broad base and a nodular surface. There are three smaller nodules scattered over the surface of the scapula. Multiple osteoenchondromas.

CLINICAL CONFERENCE, HOSPITAL FOR THE RUPTURED AND CRIPPLED, NEW YORK, OCTOBER 30, 1924.

THE PRESIDENT, DR. KRIDA, IN THE CHAIR.

DR. F. ADAIR—Intrascapulo-thoracic Amputation for Osteogenic Sarcoma of Humerus.

Dr. Adair presented a case as an example of very radical surgery in the treatment of complicated malignant bone disease, which to date has shown a good result in a case where the immediate operative mortality—according to J. W. White—runs from 6% to 10% due to shock.

The patient came from the Long-Bone Sarcoma Service of Dr. William B. Coley at Memorial Hospital.

O. B., age 40, white, male, came to the hospital on October 12, 1923, with the following history: About April, 1923, the patient began to have severe neuralgic pain in the region of the head of the right humerus. In June, 1923, he noticed a diffuse swelling at this area. In July, 1923, an operation was performed at Union Hospital, New York City, at which time profuse hemorrhage was encountered. On October 12, 1923, on admission to Memorial Hospital, there was a mass on the anterior aspect of the right shoulder,—apparently part of the head of the humerus. There was a scar of recent operation, through which was fungating vascular tissue which oozed serum. Diagnosis: Recurrent osteogenic sarcoma of the head of the humerus. Patient was given seven X-ray treatments, which did not hold the progress of the disease. The tumor fungated through the skin, steadily and rapidly growing in every direction. From the absorption of the septic necrotic tissue the patient fast went down hill, running a temperature of 101 to 104 degrees, and being delirious part of the time. The haemoglobin went down to 33%. Amputation was considered and rejected on account of the shock. Zinc chloride paste was applied in an attempt to do away with some of the absorption of the necrotic sloughing mass. Acute osteomyelitis of the entire humerus followed later. With this rather desperate setting,—a huge sloughing tumor, haemoglobin 33%, sepsis, acute osteomyelitis, delirium, pulse 126, etc.,—preparations were made for blood transfusion, to be followed immediately by intrascapulo-thoracic amputation. It was necessary, however, to first perform the amputation, then the transfusion. This produced a rather profound shock. On completion of the operation, transfusion of 1000 c.c. of blood was done, and patient's condition immediately improved and continued steadily. He left the hospital twenty-eight days later. He gained thirty pounds in weight, and at the present date—seven months after operation—he is in splendid physical condition, without any sign of local recurrence, or any X-ray evidence of sarcoma in the chest. He is working as an inspector on ships.

The danger of profound shock in the operation is due somewhat to the size of the operation; but principally to the shock of severing the big roots of the brachial plexus. This shock can be greatly reduced by injecting the nerves with ½% novocain or 95% alcohol before the bisection of the nerve roots.

DISCUSSION BY DR. WILLIAM B. COLEY—(CASE PRESENTED BY DR. ADAIR).

The case that Dr. Adair has shown is of extreme interest, as it brings up the question of the treatment and prognosis of sarcoma of the long bones, particularly of the humerus. In this case, an exploratory operation was performed at the Union Hospital, New York, in September, 1923. One month later, October 18, 1923, the patient was admitted to the Out-Patient Department of the Memorial Hospital, where he was treated entirely with high voltage X-rays. At this time his condition was that of an early operable stage of sarcoma of the upper end of the humerus. Four months' treatment with the X-rays failed to prevent a steady and fairly rapid growth of the tumor. In March, 1924, when he was shown at the weekly clinical conference of the hospital staff, examination revealed a large fungating infected tumor, and his general condition was so bad that it was doubtful if he would survive an interscapular humeral amputation. I advised admitting him to the hospital and making an attempt to build up his general condition sufficiently to warrant operation. I congratulate Dr. Adair on the success of the operation, inasmuch as the patient's condition at that time was very poor and he could not have survived without a transfusion. While he has shown marked improvement since the operation and is now well six months later, I believe that the prognosis is still bad.

We know that sarcoma of the humerus is the most malignant of all types of long-bone sarcoma, and that there are very few cases cited in surgical literature in which a recovery has been effected by amputation alone. At a symposium on Long-bone Sarcoma before the Royal College of Surgeons in November, 1912, at which all of the cases observed at St. Thomas' and St. Bartholomew's Hospitals were reported, there was not a single case recorded of a periosteal sarcoma of the humerus that had survived a period of three years. Also, at a symposium on Long-bone Sarcoma before the Association of British Surgeons in May, 1923, no case of periosteal sarcoma of the humerus was reported that had been cured by amputation.

It is interesting to analyze briefly all of the cases that have come under my observation in the Long-Bone Department of the Memorial Hospital, together with those cases of sarcoma of the long bones that have kindly been referred to me by my colleagues at the Hospital for Ruptured and Crippled during the past thirty years. Here we have a total of sixty cases of sarcoma of the humerus; seventeen of these were inoperable at the time of first operation, and forty-three were operable,—that is, not beyond amputation. Of this series, five periosteal and one central have remained well for a period of five to twenty-four years. A brief note in regard to the treatment in these six cases will be of interest:

Case 1—Case of Dr. J. Bapst Blake of Boston. A sarcoma of the upper end of the humerus involving the scapula, in which he had advised interscapular-thoracic amputation, but the patient would not consent to it. She received treatment with the mixed toxins of erysipelas and bacillus prodigiosus alone. The tumor entirely disappeared and she remained well for a period of twenty-four years, after which she died of spinal metastases. Microscopic examination of the original tumor by Dr. F. B. Mallory, Professor of Pathology of the Harvard Medical School, proved it to be a large round-cell osteo-sarcoma. No autopsy was performed and there is no microscopic confirmation of the secondary tumor, but the clinical findings left little doubt of the diagnosis of malignant tumor of spine.

Case 2—Sarcoma of the mid-shaft of the humerus in a young adult. The tumor developed after a spiral fracture, but the X-ray plates taken at this time showed no pathologic condition. The patient was referred to me by Dr. J. M. T. Finney, of Baltimore, for toxin treatment, as Dr. Finney did not believe that amputation offered much hope of benefit. By this time a pathologic fracture had occurred. Under the toxins alone the tumor promptly disappeared, the fracture re-united, and the patient remained well for six months, when the disease recurred and I did a shoulder-joint amputation. An extensive recurrence took place in the soft parts of the pectoral region; partial removal and the toxins continued; the patient remained well for eight years, and then died of metastases to the lungs.

Case 3—A spindle-cell sarcoma of the humerus that had been treated at the Memorial Hospital for a long period with X-rays; later resection of the humerus by Dr. Nathan Green. The patient has remained well for six years.

Case 4—A periosteal chondro-sarcoma of the upper end of the humerus; resection by Dr. Hitzrot; later referred to the Memorial Hospital for prophylactic treatment; received 75,000 mc. hours of radium. The patient has remained well for five years.

Case 5—A case of Dr. Quick. A periosteal sarcoma of the lower end of the humerus without any involvement of the bone itself; radium treatment without benefit; rapid increase in size of the tumor; amputation by Dr. Quick. The patient has been well now three years.

Case 6—A central giant-cell sarcoma of the upper end of the humerus which I treated with a combination of toxins and radium. The patient has been well now five years; limb saved.

In addition to the foregoing, there is another case treated by Dr. John L. Gibbon, under my direction: a young girl with a fibro-sarcoma of the shaft of the humerus, in which amputation was advised but refused; the toxins and X-rays were used, and this patient has remained well for fifteen years; limb saved.

It is interesting to note that in six of these seven cases the limb was saved; furthermore that in the entire list of forty-five operable cases not a single case was cured by amputation or resection alone. So far, at the Memorial Hospital, we have no case of periosteal osteogenic sarcoma in which the diagnosis has been definitely established by microscopic examination, treated by radium or X-rays alone, that has remained well for a period of three years.

There is a certain group of periosteal sarcomas, in which I believe it is unwise to try conservative treatment of any kind. This group is characterized by rapid growth, associated with considerable new bone formation. Here I believe that neither radium, X-rays, nor toxins offer any hope of curing the patient, and that early amputation is indicated. While amputation alone has offered little hope of effecting a cure, amputation followed by prolonged toxin-treatment has resulted in nearly fifty per cent of the patients remaining well for a period of three years. I believe that these results justify us in regarding early amputation followed by prolonged treatment with the mixed toxins of erysipelas and bacillus prodigiosus as the method of choice in this group of cases.

Dr. I. Zadek—Angioma of Semimembranosus Muscle.

Dr. Zadek presented the following case. M. A., 8 years of age. Angioma, semimembranosus, left. Admitted to the hospital October 1, 1924. Discharged October 20, 1924.

Patient's mother has observed swelling in back of the left knee for the past twelve months. She is quite sure that the swelling varies in size and that when it is large patient has discomfort and limps, and at these times the swelling is sensitive to the touch.

On examination, there is a swelling in the popliteal space on the left, which is rather indefinite in outline, but which diminishes the prominence of the usual soft-part landmarks. There is no effusion into the knee joint. The knee is held at an angle of 165 degrees. Motion of the knee can be carried out completely. The swelling is roughly the size of the palm of one's hand. It does not fluctuate, but there is a feeling of resistance, which suggests a fatty tumor. No definite outline can be made out. X-ray examination of the knee is negative.

Operation October 2, 1924: An incision was made directly over the popliteal space, and the deep fascia was split. No tumor mass was encountered. The semimembranosus tendon was considerably larger than it should be. The enlargement was diffuse, of fairly uniform thickness throughout the part presenting in the incision. The semimembranosus muscle was pulled to one side and the space underneath this muscle explored, but no tumor found. Through this deeper exploration a discolored area was noticed in the muscle, which resembled a small hematoma. The fibres of the semimembranosus muscles were separated and in this substance was found an angioma which was about the size of a small hen's egg and in distribution was somewhat diffuse. It was removed, taking some of the fibres of the muscle with it. There was very little bleeding. The deeper structures were closed with catgut and the skin closed with silk. Soft dressings applied.

October 20, 1924: Patient's wound healed per primam. Sutures were removed on the sixth day, but she was kept in the hospital until today, because in the routine examination a culture positive of diphtheria was found, though patient never showed any symptoms of the condition. She was kept in the hospital until three negative cultures were obtained. Function of the knee now normal.

DR. A. KRIDA—Arthroplasty of Metacarpo-Phalangeal Joint.

Dr. Krida stated that there is a general impression that reconstructive surgery of the smaller joints of the hand is unsatisfactory. That this is not necessarily so is shown by the work of Bunnell. Next to the "atraumatic" operative technique advocated by him, the selection of cases and the procedures suitable to each case are of great importance in determining a satisfactory outcome.

He presented the case of a young native West Indian who, eight months prior to operation, had sustained a fracture of the head of the fourth metacarpal bone while playing cricket. He had been treated at one of the large general hospitals, and the treatment had included traction on the fourth finger. Despite considerable assiduity in early treatment and a good deal of subsequent physiotherapeutic treatment, the joint became stiff and painful. There were present about ten degrees of movement, from 170 to 160 degrees, and grating in the joint. The roentgenogram showed that the very short head fragment had become subluxated and united to the palmar aspect of the shaft.

Operation was performed on November 26, 1923. The head fragment was found as above described, and, in addition, was axially rotated. This was removed, sacrificing about one quarter of an inch of the length of the bone. The stump was rounded off and a piece of fascia lata was draped over it.

Motion was encouraged from the beginning, and from the tenth day onward increasingly strong passive motion was instituted, which was continued for about six weeks. The range of motion at present is complete, there is no pain, and the power in the finger is good.

DR. I. BALENSWEIG—Thromboangiitis Obliterans. One Case Six Months After Periarterial Sympathectomy.

Dr. Balensweig presented the case of J. W., male; age 29; Russian by birth; occupation, printer. Past history negative. Habits: incessant cigarette smoker, averaging thirty per day. Family history: No similar condition in immediate or remote family. Present history: Patient states that he was perfectly well up until April 11, 1924, when, while at work at printing press, an iron roller fell from a height of four feet, landing across the left forefoot. He continued at work for three days without consulting a physician, during which period the foot became swollen and discolored. He then consulted a physician who treated him for a cellulitis of the foot. He was forced to stop work after a week because of persistent pain in both the foot and calf of leg. His physician then attempted a minor operation on the great toe and since then the toe has become increasingly painful, interrupting sleep, and necessitating the use of crutches when getting about. The site of the operation failed to heal and became gangrenous, and for this I was consulted on May 10, 1924, the examination disclosing the following: Patient appears acutely ill, suffering intense pain, and walking about with the aid of crutches, without bearing weight on the left foot. The entire foot is edematous and congested. The large toe presents a sloughing, foul area in its distal third. There is an absence of pulsation of both the dorsalis pedis and posterior tibial vessels on the left side; those on the right side are palpable. Roentgenogram of the left forefoot shows no evidence of fracture or bone disease. Patient was admitted to the Hospital for Ruptured and Crippled on May 12, 1924, where for the following week he received diathermia to the left lower extremity, warm boric acid soaks, and intravenous injections of 2% sodium citrate. The Wassermann reaction was negative.

On May 19th, a periarterial sympathectomy was performed on the left femoral artery in the upper portion of Hunter's adductor canal. The operation was followed in a few days by relief from pain, the edema completely subsided, with increased warmth of the foot. The patient for the first time in five weeks was able to sleep in bed. On June 2, the large toe was disarticulated at the metatarso-phalangeal joint because of persistent pain, and the patient felt that if this were done he would become completely relieved of the symptoms. He was discharged from the hospital on June 30 completely relieved of pain, the wound of the forefoot healing by second intention, and with pulsation of the posterior tibial vessel, this latter condition having been observed for the past few weeks.

Since discharge from the hospital, the patient has been receiving physiotherapy, and when last seen, October 27th, the wound of the foot was found to be closed, this having taken place two weeks prior to the last examination. He is now able to get about without assistance. Neither the dorsalis pedis nor the posterior tibial vessel can be palpated. There has been no recurrence of pain, and the patient is very well pleased with the end result.

DR. N. ROSEN—Traction Fracture of Tarsal Scaphoid.

Dr. Rosen presented a case of traction fracture of the scaphoid of the foot with the following history: Two months ago while walking, patient stepped into a hole in the

ground, forcibly turning her left foot outward. She stated that following this she could not turn her foot back again nor support her weight on it and that the pain was very severe. Moderate swelling followed and she bandaged the foot herself. After four days the patient started walking, dragging her foot with difficulty. It gradually became better, but the severe pain persisted. Four weeks ago patient consulted a physician for a cold, and he bandaged the foot, which gave much relief. Patient still limps on walking and there is marked pain in the foot at night.

Examination shows the patient presents double weak feet. There is marked prominence of the left scaphoid. The bone is exceedingly tender on pressure and appears abnormally mobile. Antero-posterior motion of foot is practically normal. Inversion is restricted to about 75% and eversion to 50% of normal. Patient refused operation for removal of the fragment and the treatment then was a special Whitman brace with a high inner flange and physiotherapy. At present the patient walks with more comfort and there is much less pain. X-ray findings show a fracture of the left scaphoid with about one-eighth of an inch separation of the fragments.

Correspondence

February 24, 1925.

To the Editor, Journal of Bone and Joint Surgery:

Thank you for calling my attention to the article by Mr. Fisher in the *Lancet* of May, 1923, in which he describes the curved incision for exploration of the knee joint. At the time of the issue of my article in the *Journal of Bone and Joint Surgery*, I had seen neither his article nor the book on the Internal Derangements of the Knee Joint, or I should have given mention of his earlier description of this mode of entrance. I am taking this opportunity to make this acknowledgment to him through the pages of your Journal.

The incisions are different in what seems to me an essential detail. Splitting the fascia in the mid-line makes it impossible to use Mr. Fisher's incision for an operation requiring only a limited exposure, such as for excision of a semilunar cartilage, whereas the incision I use may be made limited at first, and subsequently enlarged should the occasion demand it.

Yours sincerely,

ARTHUR KRIDA.

News Notes

The Annual Meeting of the American Orthopedic Association will be held in Washington on May 4, 5, and 6. The morning of Monday, the fourth of May, will probably be devoted to a clinical meeting, and the other two days to the meeting proper. The sessions will be held at the Hotel Washington.

Further details concerning the meeting may be obtained from Dr. DeForest P. Willard, 1630 Spruce Street, Philadelphia.

A preliminary programme, subject to changes, has been arranged as follows:

MONDAY, MAY 4, 1925.

MORNING SESSION.

9.30 A.M.

1. Address of Welcome by President.
2. A Motion Picture Demonstration of the Davis Method for the Reduction of Congenital Dislocation of the Hip. Dr. Frank D. Dickson.
3. The Bifurcation Operation for the Treatment of Irreducible Dislocation of the Hip Joint. Dr. Rudolph S. Reich (*by invitation*).
4. Paralytic Abduction Deformity of the Hip and its Operative Treatment. Dr. Leo Mayer.
5. The Rôle of the Tensor Fasciae Latae in Various Deformities of the Hip and Knee. Dr. C. C. Yount (candidate's thesis).
6. Congenital Elevation of the Scapula with Treatment. Dr. Robert D. Schrock.

TUESDAY, MAY 5, 1925.

MORNING SESSION.

9.30 A.M.

1. Results of Sacro-iliac Arthrodeses in Cases of Strain. Dr. M. N. Smith-Petersen.
2. Malformations of the Lower Spine Based on an X-ray Study of Children. Dr. Archer O'Reilly.
3. An Unusual Case of Paraplegia Associated with Marked Gibbus and a Collection of Fat. Dr. Ernest Sachs (*by invitation*).
4. Vertebral Epiphysitis—A Cause of Spinal Deformity. Dr. Joseph Buchman (*by invitation*).
5. The Bone Cell and Its Activities. Dr. Sydney M. Cone.
6. Neuritic Forms of Polyarthritis. Dr. Philip W. Nathan.

WEDNESDAY, MAY 6, 1925.

MORNING SESSION.

9.30 A.M.

1. President's Address.
2. Haemophilia—with Volkmann's Syndrome. Dr. J. F. Lord.
3. Trophic Osteopathy. Dr. E. B. Mumford (candidate's thesis).
4. Osteosclerosis Corresponding with the Distribution of the Ulnar Nerve, an Unclassified Bone Condition. Dr. Philip Lewin.
5. Periarterial Sympathectomy. Dr. George P. Muller (*by invitation*).
6. The Late Treatment of Rupture of the Ligamentum Patellae, Patella, and Quadriceps Tendon. Dr. W. Edward Gallie.
7. Carpal Fractures and Dislocations. Dr. Kellogg Speed (*by invitation*).
8. The Relative Importance of Wound Treatment and Immobilization in the Treatment of Compound Fractures. Dr. H. Winnett Orr.

The British Orthopædic Association will hold two meetings during the year 1925. The first, or Summer meeting, will be held at Oxford on April 17 and 18.

The Annual Meeting will be held in Manchester on October 23 and 24. The Provisional Programme is as follows:

FRIDAY, OCTOBER 23, 1925.

MORNING SESSION.
(At the UNIVERSITY MEDICAL SCHOOL.)

9.30 A.M. Annual General Meeting.
10.00 A.M. Discussion on "Fractures in the Region of the Ankle Joint," to be opened by Mr. Harry Platt.

AFTERNOON SESSION.

2.00 P.M. Demonstration of patients and operations at the Ancoats Hospital.
7.30 P.M. Annual Dinner, Midland Hotel.

SATURDAY, OCTOBER 24, 1925.

MORNING SESSION.
(At the UNIVERSITY MEDICAL SCHOOL.)

9.30 A.M. Short Papers.

AFTERNOON SESSION.

2.00 P.M. Visits to Hospitals.

The Halcyon Hospital of South Boston, Virginia, announces the organization of an Orthopædic Department in charge of Dr. John Blair Fitts and Dr. Thomas Wheeldon of Richmond.

On November 8, the Los Angeles Orthopædic Society held a Clinical Meeting, to which the members of the San Francisco Orthopædic Club were invited.

This was one of the regular bi-monthly meetings of the Los Angeles Society, and one of the two semi-annual clinical meetings which it is proposed to hold alternately at Los Angeles and San Francisco, by arrangement with the San Francisco Orthopædic Club.

Guests were Drs. Watkins, Stoddard, Bull, Cleary, Lowe, and Dresel, from San Francisco, and Dr. Harding from San Diego.

Clinics were held as follows:

LOS ANGELES GENERAL HOSPITAL.

Dr. Homer W. Spiers showed a case of spondylolisthesis. A woman, 65 years of age; injured February, 1924, by lifting a trunk, during which effort she had a sudden severe pain in her low back. From that time on had constant, increasing low back trouble. A brace was supplied, with only partial relief. Entered the hospital in August, six months after the injury. Recumbency gave some relief. Antero-posterior roentgenogram was thought to be negative. Lateral views showed a slight forward luxation of the fifth lumbar vertebra on the sacrum. A gas manipulation was tried without results. On August 26, 1924, a Hibbs fusion was performed. The lamina of the fifth lumbar vertebra was found fractured to the right of the spinous process and just anterior to the right articular facets. The fragment of the lamina was freely movable. When the spinous process of the fifth lumbar vertebra was grasped by heavy forceps, the vertebra could be moved forward and backward on the sacrum a distance estimated at one-half inch. A later study of the antero-posterior films revealed definite evidence of the fracture which had been overlooked in the pre-operative examination. It was the opinion of Dr. Spiers that such a case as this throws light on the diagnosis of some of the more obscure back injuries.

Dr. Steele F. Stewart presented a case showing the end result of a Claremont Operation for recurrent dislocation of the shoulder.

Dr. Alfred E. Gallant showed a case of Charcot spine and the end result of an Albee fusion operation for tubercular spine.

Dr. Trusten M. Hart presented two cases of arthroplasty for ankylosis of the elbow, showing end results. He also showed some original surgical instruments for bone operations in deep cavities, the idea having been suggested by the instruments used by artificial leg makers.

Dr. John Dunlop operated on a case of subdeltoid bursitis, from which a chalky deposit was evacuated.

Dr. John C. Wilson showed some cases and roentgenograms of fractures of the femoral neck.

Dr. William Arthur Clark showed a case of annular scar above the ankle, following a severe injury, without fracture, in a boy of ten, in which a marked edema was present and a bad deformity developing in the foot as a result of the scar. On account of infection no apparatus was successful in counteracting the deformity. Dr. Watkins said to let it alone until the skin had completely healed, then to do whatever reconstructive operation was necessary to give a weight-bearing foot.

At the CHILDREN'S HOSPITAL:

Dr. John C. Wilson showed several cases of tubercular hip and osteomyelitis, as well as a case of Hibbs' fusion for paralytic scoliosis.

Dr. Steele F. Stewart showed the end result of a Soutter operation for flexion contracture of the hip, a fracture of the tibia treated by a Delbet plaster splint, and a case of fragilitas ossium.

Dr. Homer W. Spiers presented an end result after an open operation on a congenital hip, and a case of neuroplasty in the leg.

At the ORTHOPAEDIC HOSPITAL SCHOOL:

Cases were shown by Drs. Charles L. Lowman, Harold D. Barnard, and Edward N. Reed. Dr. Lowman presented a series of scoliosis cases treated by fusion, bed traction, plaster jackets, exercise, etc., showing results obtained in the cases during a number of years. He also demonstrated the gravity traction method for scoliotics as used at the Orthopaedic Hospital School, showing the advantages over other methods for bed treatment. Two cases of congenital dislocation of the hip treated by open reduction were shown with the functional end result. Two cases of flat feet treated by the Lowman operative method were also demonstrated. Dr. Barnard demonstrated a case of severe flexion contracture at the hip, operated upon by the Campbell method, transplanting the crest of the ilium, a case of fracture of the inner condyle of the humerus, with delayed involvement of the ulnar nerve, treated by transplantation of the nerve to the anterior aspect of the elbow after the method of Stiles. Dr. Barnard also demonstrated five cases of osteomyelitis, in which the surgical treatment had been augmented by intravenous mercurochrome, with decided benefit.

The visitors were shown over the entire Hospital and Clinic.

After a dinner at the University Club, the evening meeting was called to order by the President, Dr. John Dunlop.

Dr. Edward C. Bull, of San Francisco, read an instructive paper on the treatment of spastic paralysis, with special reference to the Royle operation. This was followed by an interesting discussion.

Dr. William Arthur Clark, of Pasadena, is the Secretary of the Club.

The Section in Orthopedic Surgery, New York Academy of Medicine, met on Friday evening, January 16, 1925.

The programme was as follows:

PRESENTATION OF PATIENTS AND CASE REPORTS.

(*a*) Fracture-dislocation of the astragalus, in a child. David H. M. Gillespie.
(*b*) Arthroplasty of the hip for bony ankylosis. Toufick Nicola (*by invitation*).
(*c*) Tumors of the foot:
  1. Osteogenic sarcoma (one case).
  2. Endothelioma (two cases). Bradley L. Coley (*by invitation*).
(*d*) Periarterial sympathectomy for various conditions:
  1. Trophic ulcers (three cases).
  2. Traumatic ulcer of leg (one case).
  3. Old poliomyelitis: chilblains (one case).

4. Scleroderma (one case). Arthur Krida.

(*e*) 1. Dislocated astragalus: open reduction.
2. Tarsal ankylosis: Neisserian infection. Richmond Stephens (*by invitation*).

(*f*) Arthrodesis of the shoulder for disability following infantile paralysis. Isidore Zadek.

(*g*) Traumatic (obstetrical) sacro-iliac dislocation. Sacro-iliac arthrodesis by the method of Smith-Petersen. Armitage Whitman.

(*h*) Cases of synovectomy of the knee joint. Percy W. Roberts.

PAPERS OF THE EVENING.

1. End-result study of epiphyseal separations of the hip. Irvin Balensweig (*by invitation*).
2. Vertebral epiphysitis,—a cause of spinal deformity. Joseph Buchman (*by invitation*).

On the evening of Friday, February 20, 1925, the following programme was arranged:

DEMONSTRATION OF INSTRUMENTS, PRESENTATION OF PATIENTS, CASE REPORTS.
(*From the Hospital for Joint Diseases.*)

(*a*) 1. Lorenz Osteoclast.
2. Stille-Lorenz Osteoclast. Walter I. Galland.

(*b*) "Bi-plane Fluoroscopy in the Treatment of Fractures, with New Radiolucent Fracture Stretcher and New Surgical X-ray Unit." Herman B. Philips.

(*c*) Two stage redressment of flat feet. Walter I. Galland.

(*d*) The result of radiation of endothelioma of the femur with pathological fracture. Irwin W. Alpert.

(*e*) Unusual hip condition. (Report of case.) Maurice M. Pomeranz.

(*f*) Case of multiple bone tumors. Harry C. Stein.

(*g*) Giant cell tumor of unusual interest following fracture of femur. Eugene H. Eising

(*h*) Atypical case of tubercular elbow. Albert L. Levy.

(*i*) Cases of traumatic synovitis treated by aspiration and immediate mobilization. Henry Milch.

(*j*) 1. Case report of solitary cortical abscess of the femur. (Lantern slides of three cases.)
2. Chondral and osteo-chondral fracture of articular surface of the femur (osteochondritis dissecans). Lantern slides of an operated case. Walter M. Brickner.

PAPERS OF THE EVENING.

1. Sciatica. A neuro-orthopædic consideration. Charles Rosenheck. Harry Finkelstein.
2. Congenital Dislocation of the Hip. Robert Soutter, Boston, Mass. (*by invitation*).

A meeting was also held on the evening of March 20 and the programme was as follows:

PRESENTATION OF CASES AND CASE REPORTS
(From Mount Sinai Hospital)

(*a*) Abscess of the femoral neck in a three-year old child; operative result. Sigmund Epstein.
(*b*) An interesting case of syphilitic epiphysitis. Seth Selig (*by invitation*).
(*c*) Multiple chronic tuberculous sinuses treated by radiotherapy. Samuel Stern and Maurice Lenz (*by invitation*).
(*d*) Dyschondroplasia: demonstration of patients. Isidor Zadek.
(*e*) Chronic arthritis cases treated with typhoid bacilli intravenously. Salo N. Weber (*by invitation*).
(*f*) 1. Bone-growth disturbances with endocrine imbalance.
2. Isolated Serratus Magnus palsy. Edgar D. Oppenheimer.
(*g*) Implantation of extensor longus digitorum tendons for claw-foot. P. Wm. Nathan and Edgar D. Oppenheimer.
(*h*) Paper: Treatment of acute coxitis. P. Wm. Nathan.
(*i*) X-ray demonstration: Bone Tumors. Leopold Jaches.

At its forty-sixth meeting held in New York, January 16, 1925, during the morning session the Conference Board of Physicians in Industry reviewed the methods in use for the care of trivial injuries. The physicians who attended this meeting are engaged in the medical supervision of approximately 400,000 men, and their reports and discussions were therefore based on wide experience and knowledge of the industrial problem. While it was agreed that many trifling injuries created no disability and required no redressing, it was also stated that many serious infections entailing much loss of time and production arose from the neglect of such cases. This was emphasized by figures on infections submitted by the members. Over 2,000 infection cases were reported among 32,500 workers during 1924, and of this number only about twenty had received treatment prior to the appearance of the infection. It was thus seen that where prompt medical attention is given to injuries, infections are practically eliminated, and that practically all infections in such injuries result from delay in reporting for treatment.

In view of the experience of the members as noted above, it was the consensus of opinion that all industrial injuries should have first aid treatment, which in the absence of physician or nurse might be given by a trained first aid attendant. Where this was done and the employee continued at his regular work without visiting the medical department, a record of the case should be made by the one rendering the initial treatment, and sent immediately to the medical department. The physician should either see these cases or obtain a report on them within twenty-four or forty-eight hours. It is much better for the physician or nurse to treat all injuries, but, in large plants, particularly those with scattered units, this is not practical and under the circumstances the services of trained first aid attendants may be utilized.

The treatment of more serious cases was also discussed, particularly those cases drawing compensation benefits. In the experience of the members the most beneficial results to the worker who is recovering from an injury are obtained in cases where he is returned to employment pending complete recovery. Certain types of workers are

unfavorably influenced by prolonged periods of idleness pending complete recovery and it is hard to get such persons to again take up their usual employment. Compensation boards frequently permit the worker to prolong his idleness on the ground that he has not recovered from the effects of the injury.

It was the unanimous conclusion of the Board that these practices were factors in delayed recovery and the development of traumatic neurosis and certain cases of malingering. It was urged that compensation boards give more careful consideration to the question of returning the injured worker to some sort of employment as soon as it was safe to do so. It has been the experience of members that many injured workers will do better active work with the injured part at their regular occupation than they will by going through passive movements and specified active exercises at home or in a physiotherapeutic clinic. The mental stimulation which comes from regular employment is much more beneficial than that obtained in a clinic where the patient has nothing to divert his attention from his own injuries and those of others around him.

It is realized that in many cases a certain amount of physiotherapeutic treatment is necessary before any work can be attempted. The Board believes, however, that supervised active motion of the previously injured part, carried out as work in the factory, leads to more prompt recovery than any other form of treatment.

The afternoon session was devoted to the consideration of the injuries of the low back, with particular reference to residual cases, their diagnosis and treatment, and a paper was presented by Dr. E. G. Brackett of Boston in which the etiologic factors of resistent and persistent cases were considered. It was shown that in a large number of this group there are anomalies either from pathologic change, or of congenital anomalies of structure, particularly of the lumbo-sacral area, both of which establish definite potential weakness. Discussion in this paper was confined to the latter group, that comprising anomalies of structure and development, and it was shown that spines possessing these anomalies are often quite able to perform for many years the ordinary routine work in the active life of a laboring man, but that they yield easily to even ordinary stress, which may be expected to occur in the routine of labor, and these backs do not recover from such strains in the ordinary manner and time as do normal spines. Spines that present the varieties of the low back anomaly are, therefore, not to be considered as able to endure without risk the stress often incident to severe, yet normal, physical labor.

The discussion of the paper was opened by Dr. Whitman, who considered the same subject, and also cases of fracture, often unsuspected, which may occur in the ordinary life of laboring individuals, frequently without marked violence. The members attending the conference discussed fully the different phases of this low back problem, which was recognized to be extremely common in all forms of industry, and which is seen in the early stages by this group of surgeons.

The Franco-American Hospital for the treatment of tuberculosis, mainly bone tuberculosis, at Berck-Plage, was opened on the first of January. Special opportunity is offered in this hospital for the study of problems in the diagnosis and treatment of tuberculous lesions, and particularly of the secondary lesions accompanying bone and joint disease. The hospital offers special facilities for hospital graduates or surgeons who

are interested in this problem, and who wish to take a service of some months or more and to work under the direction of the surgeon in charge. This opportunity is offered, and a charge is made of only twenty francs a day to cover the actual expense of room and board in the hospital, and includes instruction. Application should be made to Dr. Jacques Calvé, Berck-Plage, France.

BOOK REVIEWS

THE CARE, CURE, AND EDUCATION OF THE CRIPPLED CHILD. A Study of American Social and Professional Facilities to Care for, Cure, and Educate Crippled Children. A Complete Bibliography of Literature bearing on this subject; and a Complete Directory of Institutions and Agencies engaged in this work. By Henry Edward Abt, Director Bureau of Information of the International Society for Crippled Children. Published by The International Society for Crippled Children. Elyria, Ohio, 1924.

To those who have heard the addresses of Mr. E. F. Allen and have seen the institution in Elyria, Ohio, in which he is interested, this book will appeal at once. The book may be said to represent the accumulation of his knowledge, as well as the progress of his ideas, for the past twelve years. To those who are unfamiliar with the progress that has been made in the United States during the last twelve years in the matter of providing hospitals and clinics for the care of cripples, the book will reveal much. Both Mr. Allen and Mr. Abt are working chiefly, at present, through the Rotary Clubs of the United States and Canada. It is evidently their intention, however, to influence other groups of people who are interested in this work or who may become so. That a realization of this ambition of theirs will be helped by this book can not be doubted.

While this is not an orthopædic text book, nor a contribution to the scientific care of crippled patients, yet it may certainly be said that on the sociological side the book, if it is widely circulated, will do a great deal of good. The writer of this review has the feeling that Mr. Abt and the International Society have done for us, as surgeons, something that might well have been done for the patients and for ourselves sometime ago. In other words, they are disseminating to the general public a kind and an amount of knowledge which we have had for a long time but which for some peculiar and supposed ethical reason we have kept to ourselves.

This little book gives, I am glad to say, the greatest credit to the work of Mrs. Edith Reeves Solenberger, Mr. Joe Sullivan, and Mr. Douglas McMurtrie. For the work of these and of Mr. Allen we may well extend our word of thanks and appreciation. Also we may hope that this booklet will be re-issued in a later edition or editions with additions and improvements that will make it a growing reference work in regard to the development of hospitals and schools for cripples, for which there is still a tremendous need.

FRACTURES AND DISLOCATIONS. P. D. Wilson, A.B., M.D., F.A.C.S., and W. A. Cochrane, M.D., Ch.B., F.R.C.S. Edin. Philadelphia and London: J. B. Lippincott Company, 1925.

The work is based on the knowledge gained in the treatment of fractures and dislocations during the World War and the application of this type of treatment to cases met with in civil practice and in hospital clinics.

The first three chapters deal with general principles, splinting, X-ray examination, compound fractures, débridement, Carrel-Dakin, etc. Two chapters then describe in detail the treatment of injuries of the shoulder girdle, following which is a chapter each on the humerus, elbow, forearm, wrist, and hand. The regions are each studied anatom-

ically, with good illustrations to show the muscular attachments and other important structures of the part, and good roentgenographic reproductions and pictures show the methods of reduction and correct splinting. Each region with its fractures and dislocations is similarly considered in turn.

Throughout the book the evident value of thorough anatomic knowledge is apparent and adds clearness to the description of the fractures and the method of applying the principles of reduction. The modern trend of attacking many of the fractures in a clear, decisive, operative method is emphasized in this book, and should be considered one of its valuable features.

The descriptive text is clear, well written, and well arranged. There is practically nothing original with the authors, and no claim for originality is made, but there is nothing in the book which has not been thoroughly studied and tried out, and which therefore has ground for endorsement. Many of the illustrations are of cases treated during the past years at the hospital clinic of the authors, and in fact, the book gives evidence of the authors' large hospital experience and presents a recognized treatment which has been established in a fracture service. It is a valuable book of reference.

Anatomie des Membres. Deuxième Édition. Paris: Masson et Cie., 1924. By Dr. Ch. Dujarier, Chirurgien de l'hôpital Boucicaut.

This atlas of the extremities is particularly rich in detail and accuracy. The relationship of all vital structures are shown in the same plate in a way that is extremely helpful. The plates are numerous, the drawings excellent, and the text explicit. The usefulness of this volume to surgeons who are doing work on the extremities will be great and students of anatomy will find it an excellent reference. The plates alone will make it of great value even to those who are not familiar with the French language. One has only to glance at one of these illustrations to appreciate the extraordinarily painstaking and extensive work that the author has devoted to his dissections and artistic details.

Infantile Paralysis in Vermont, 1894–1922. State of Vermont, Department of Public Health, 1924.

Herein is told the story of Vermont's untiring effort in the warfare against infantile paralysis, of how every resource known to science, every power of organized effort, every advantage of inspired individual action is being marshalled to gain the desired goal, the conquering of this disease.

The accurate account of each phase in the campaign,—the leadership of Dr. Charles S. Caverly from 1891 to the time of his death in September, 1918; work of the Research Department, under the supervision of Dr. Simon Flexner; of the After-Care Department under Dr. Robert W. Lovett from 1914 until his untimely death in July, 1924; and of the organization, aim, and plan of work, told by Miss Bertha E. Weisbrod, R. N., —renders the book invaluable to those engaged in the solution of this problem, of great interest to those who work at all in anterior poliomyelitis, and an inspiration to all who are interested in the welfare of mankind.

INTERNATIONAL CLINICS. Vol. IV, 34th Series, December, 1924. Philadelphia: J. B. Lippincott Company.

INTERNAL FIXATION IN FRACTURES. E. L. Eliason, M.D., and Drury Hintin, M.D.

The authors, after a careful survey of the literature, in which they accept only those articles giving complete data with follow-up results, and after a careful survey of follow-up results at their own hospitals, conclude that internal fixation in proper hands and in cases where up-to-date closed methods fail, is indicated.

Further, the plate is the material of choice; where non-union obtains, the bone graft. Non-union attributed to plates is due to interference with blood supply and periosteum, either from the original violence or improper operative trauma—not to the plate. They do not state their technique in dealing with the periosteum.

Delayed union is not the fault of the internal fixation, but in spite of it. Excessive callus they attribute to bands or poor fixation. Refracture attributed to plates is largely mythical.

They recommend simple open reduction without the plate if possible.

Excellent tables giving the findings in cases in their own hospitals are included.

FRACTURES OF LUMBAR SPINE. (Review.) Carl D. Hoy, M.D.—This article deals with those fractures which are accompanied by cord symptoms.

Laminectomy is recommended, performed as quickly as the patient is out of shock and regardless of the extent of the cord symptoms. The delay incident to a policy of waiting to ascertain the extent of the injury to the cord, may jeopardize much or all of the chance of return of function. The author does not substantiate his feeling with tables, a difficult task.

The article presents a summary of the subject as it stands today, without offering any other contribution.

PHYSIO-THERAPY IN GENERAL PRACTICE AND FOR THE USE OF MASSEUSES. E. Bellis Clayton, M.B., B.Ch. (Cantab.). New York: William Wood & Co., 1924.

The author explains some of the methods employed under the headings: massage movements, radiant heat, Faradic and Galvanic currents. The diseases in which these are indicated are classified and discussed, and a detailed therapeutic plan outlined for each. The author's conception of the underlying morbid changes is given, with the rationale of treatment recommended.

The therapy is that employed at King's College Hospital, London.

The work represents an effort in the right direction.

THE ADVANCE OF ORTHOPÆDIC SURGERY. A. H. Tubby, C.B., C.M.G. London: H. K. Lewis & Co., Ltd., 1924.

The book is a republication of six articles by Dr. Tubby for the Clinical Journal.

Various phases in the development of orthopædic surgery since 1912, diagnostic and therapeutic, are reviewed in a philosophical vein. Some of the methods recommended, while they may not be everywhere subscribed to, are based on the author's experience of thirty-five years.

The ideas on the preparatory training for the practice of orthopædic surgery are heartily endorsed.

A well chosen bibliography is included.

Current Literature

FRACTURES AND DISLOCATIONS

RATIONAL TREATMENT OF FRACTURES IN THE REGION OF THE ELBOW JOINT. Samuel W. Boorstein. *Med. Journ. and Record.* November 5, 1924, p. cxxxiv.

Boorstein favors the flexed position of the elbow in the treatment of all elbow fractures except that of the olecranon. In this he follows Jones's dictum and plays safe. In the following conclusions he summarizes what he considers "proper treatment of fractures of the elbow-joint:

1. Proper attention should be paid to treatment of fractures, as better and quicker results are now expected.

2. Early reduction is absolutely necessary.

3. Reduction should be performed with full consideration of muscle pull and not according to the traditional custom of pulling by direct extension.

4. When possible, the fracture should be reduced under the fluoroscope.

5. Restoration of anatomic position should be the aim, but partial lateral displacement or impaction without alteration of the axis of the limb is allowed.

6. Prolonged immobilization is harmful.

7. Massage should be commenced very early, about the third or fifth day; but it must be administered very carefully and gently in the hands of an experienced masseur.

8. Active exercises are preferable to passive. These should be commenced early, as they prevent stiffness and adhesions. They never cause pseudo-arthrosis.

9. Passive exercises may be justified only at the end of the treatment to obtain full range of motion, but even these should be done gently.

10. A roentgenogram should be taken before and immediately after reduction, and at frequent intervals during the course of treatment. The patient should not be discharged without a final roentgen ray examination."

The author takes up the different fractures at the elbow and discusses the application of these principles to the individual cases. In speaking of position, he says "The proper position is only of secondary importance; the after-treatment is, as in all fractures, of paramount value and must be accurately carried out." Granting the value of a certain amount of after-treatment in these fractures, it would seem to the reviewer that the amount of after-treatment is often in inverse ratio to the care given in the original correction of the deformity.

In the discussion of Volkmann's contraction, he states that it can be prevented by certain precautions in the application of apparatus. It may be hypercritical to note that Volkmann's contraction sometimes occurs without the use of any apparatus or benefit of surgery. To insure the best results in fractures of all kinds the surgeon must do most of the work himself and this is doubtless what Boorstein does.—*Charles A. Parker, M.D., Chicago.*

THE SECTIONAL PLASTER-OF-PARIS CASING WITH REFERENCE TO THE TREATMENT OF FRACTURES OF THE LEG AND ANKLE: Case Report. W. A. Cochrane. *British Journal of Surgery*, October, 1924, p. 213.

In dealing with fractures of the leg and ankle, the chief difficulty lies, not in the actual reduction of the displacement, but in maintenance of the corrected position while immobilization is being secured. A precise, simple, and eminently practical method is available for such cases. It involves the employment of a plaster-of-Paris casing applied in sections.

A case of fracture-dislocation with medial and backward displacement was easily reduced, but the backward displacement recurred very easily. To remedy this, separate plaster casings were put on and allowed to set, above and below the area involved, thus leaving the ankle free for manipulation. The surgeon was then able to correct the dislocation vigorously while the two cases were united by a third plaster bandage applied by his assistant. The surgeon's hands were out of the way of the bandage while being applied. There was thus no question of his hands requiring to alter their force or position. The whole point in the rationale of the scheme was that once reduction was effected, it was never again in jeopardy. Subsequent skiagrams showed perfect position. The method is adapted from the sectional plaster method of Fiske for the treatment of congenital club-foot. Details are given of the method employed by Wilson in fracture of both bones of the leg. There follows a description of the process of "wedging" the plaster casing to correct residual deformity.

By following out the principles illustrated above it is possible to obtain good anatomic reposition. A plea is put forward for discarding the ordinary splints and adopting plaster-of-Paris instead. By the use of the method of "wedging," fine adjustments of position are possible, especially with reference to angular deformity. *Alexander Gibson, F.R.C.S., Winnipeg, Manitoba.*

THE SACRO-ILIAC JOINT: ITS DIAGNOSIS AS DETERMINED BY THE X-RAY. Byron C Darling. *Radiology*, December, 1924, p. 486.

The paper limits itself to sacro-iliac dislocation, sub-luxation, or sprain, resulting from injury. The author hoped, and attempted for years, to demonstrate this condition from the stereoscopic roentgenograms. Within the last few years he has taken a definite negative position in this regard.

Goldthwait and Albee are quoted as considering the sacro-iliac a true joint, with joint cavity, synovial membrane, and capsule, with motion consisting of forward and backward tilting of the sacrum in relation to the ilium. In taking stereoscopic roentgenograms of the sacroiliac joints the stereoscopic shift must be with the spine, and not across it, and the pelvis and lower spine symmetrically posed in relation to the central ray.

It has been held that a separation of the sacro-iliac joint is shown by widening of the ribbon or cartilaginous space over the joint; but such widening is also produced by rotation of the pelvis toward the opposite side, as demonstrated by difference in breadth of the iliac wings, increased prominence of one ischial spine, lateral displacement of the symphysis, and asymmetry of the obturator foramen.

The author discusses the importance of diagnosis of sacro-iliac luxation in legal industrial accident cases and the great diversity of interpretation of radiograms of this

joint by roentgenologists. He quotes a number of authorities to the effect that sacro-iliac subluxation is not demonstrable by X-ray. He concludes that sacro-iliac sprain, relaxation, subluxation, or dislocation cannot be demonstrated radiographically except where there is an actual separation of the pelvic girdle by fracture or separation at the symphysis, and states that this opinion is almost unanimous among experienced roentgenologists.—*Edward N. Reed, M.D., Los Angeles, Calif.*

THE TREATMENT OF EXTERNAL LUXATION OF THE PATELLA IN CONNECTION WITH SOME OBSERVATIONS ABOUT THE PATHOLOGY OF THIS MALFORMATION. Michael Friedland. *Archiv. f. Orthop. und Unfall-Chir.*, Vol. XXIII, No. 3, 1924, pp. 352–358.

The primary factor in the mechanism of production of external displacement of the patella is to be found in the normal lateral position of the quadriceps femoris muscle. All the other symptoms, such as diminution of the inter-condyloid fossa, diminution of the external condyle of the femur and the outer half of the patella, changes in the elasticity of the joint capsule, genu valgum,—all these changes are only secondary to the abduction pull of the quadriceps muscle.

This congenital latero-position of the quadriceps femoris is a pathologic expression of a physiologic external displacement of the muscle in relation to the knee joint and the patella. This is explained through a disturbance in the spiral growth of the femur during embryonal life. The external deviation of the femur is especially noticeable in the direction of the fibers of the rectus femoris muscle.

All the acquired lateral luxations of the patella develop the easier, the more the congenital predisposition to the outward displacement, with its abduction-function, of the quadriceps is expressed.

In view of these facts, the rational treatment of an outwardly displaced patella should consist in changing the topography of the quadriceps muscle. By operative procedure, the quadriceps should be mobilized and attached to the inner muscles of the thigh, the sartorius, adductor magnus, and vastus internus. All other operations may be regarded as accessory only, and only be added if the secondary changes have developed and hinder the reposition of the patella. Capsulorhaphy and manipulative correction of the genu valgum are the most needed of the additional operations. It is essential that early postoperative physiotherapy be painstakingly executed. The author reports three cases and describes his operation in detail.—*A. Gottlieb, M.D., Los Angeles, Calif.*

FRACTURE OF RIBS BY MUSCULAR ACTION. Francis W. Palfrey. *Boston Med. and Surg. Jour.*, September 11, 1924, p. 498.

Brief reference is made to approximately ten cases seen at 22 General Hospital in Northern France during an epidemic of acute respiratory infections in 1916–17. Each case gave a history of sudden sharp pain during a violent fit of coughing, usually in the lower axilla or behind this area, followed by painful and limited respiratory movements. All showed localized tenderness, and at least three had definite crepitus. As many as three, or possibly five, similar cases have been observed in civil practice by the author in twenty years' experience.—*R. W. Billington, M.D., Nashville, Tenn.*

A Method of Treatment in Fractures of the Long Bones. Norman D. Royle, *Med. Jour. of Australia*, August 9, 1924, p. 133.

The author has devised a method of treating fractures of the long bones that is at once simple and effective and can be applied as well in the outlying districts as in the well-equipped general hospital. The author reviews briefly the results of muscular action upon a fracture, changes set up by fractures, and the current methods of treatment.

The author's methods require a knowledge of plaster-of-Paris technique, and aim at taking away the necessity for muscular action by fixing the joints in the normal position and by providing an exo-skeleton to support the soft tissues. To prevent side-displacement the joints above and below the site of fracture are first encased in plaster and allowed to set. When setting has taken place, reduction is effected by manipulation or by traction or by both, traction being made on the end-casings. The middle portion is then plastered to maintain the ends in position and to support the weight of the soft tissues. A detailed technique as applied to fractures of the tibia and fibula, the femur and humerus, and the radius and ulna is clearly given by the author. Accessory treatment is also stressed,—especially active movements—the author claims that these can be carried out at an early stage by splitting the end-casings after union has become firm. The author stresses the dangers of too vigorous massage and favors the light, superficial strokings which produce muscular relaxation and vaso-constriction reflexly. If this method is followed out there is an absence of rapid wasting of the muscles, which the author claims is an evidence of continuous action on the part of the muscles. The author favors a smooth, close-fitting covering for the skin, and recommends stockinette or some similar material and condemns the use of wool padding. The bony joints are protected with a thin layer of saddler's felt. Where swelling is feared, a piece of rubber motor tube is placed next to the stockinette, the plaster split longitudinally over this. The rubber tube may be withdrawn after this has been accomplished.—*N. T. Williamson, M.D., Montreal.*

ARTHRITIS

The Treatment of Chronic Arthritis with Sulphur. K. Isaac-Krieger and G. Noah. *Med. Klinik*, November 9, 1924, p. 1579.

Since the introduction of sulphur for the treatment of chronic infectious arthritis by the French, the effects of this treatment have been repeatedly reported in the literature. A review of the literature would lead one to expect a beneficial influence (within the limits of anatomic possibilities) on arthritic joints.

The authors tried various preparations of sulphur in cases of long standing infectious arthritis which had resisted the usual therapeutic methods. They found that "Sulfrogel" in small doses gave the most satisfactory results. (0 1 to 0 5 cc. of 0.5% sulfurgelative).

According to their experience sulphur can cause an improvement in chronic polyarthritis; nevertheless it is scarcely worthy of a special position in the series of other drugs used in the treatment of chronic joint diseases.—*E. D. Hauser, M.D., Rochester, Minn.*

Influenzal Arthritis. D. Nabarro and J. F. H. Stallman. *Lancet*, October 11, 1924, p. 743.

The writers report three cases in their own experience of this rather rare condition, with bacterial proof of the infection. They claim that from a large literature they found

but three more cases in which the bacillus influenzae was found in the joints. In all three of these cases recorded in the article the knee joint was the seat of the joint infection. They were all in babies, one year, one year, and eight months, and developed rapidly as an acute synovitis of the joint, only one having a preceding cold to suggest its origin. All affected joints contained pus. Temperatures of 102 degrees and 103 degrees were recorded, the children were very sick, and one of them died of meningitis, the other two recovering. Aspiration of the joint was followed by healing and complete function in one case; incision and drainage gave complete cure in one; while a third died after incision and drainage. Non-suppurative joints of influenzal origin are supposed to be fairly common, but those from which the influenza bacillus has been cultured are, according to these authors, exceedingly rare.—*Charles A. Parker, M.D., Chicago, Ill.*

Experimental Arthritis Deformans. A. Schmidt. *Beitr. zur klin. Chir.*, Vol. 132, 1924, p. 538.

Recently Axhausen expressed the opinion that the osteochondritis of Perthes and Köhler's disease of the metatarso-phalangeal joint belonged to the same group as arthritis deformans. Perthes and Aschoff among others immediately opposed this and during the discussion attention was drawn to the nutritional disturbances that take place in bone and cartilage and give rise to a condition very similar to arthritis deformans.

In his studies of experimental fractures of joints, the author found areas of necrosis in the bone near the epiphyseal line, which he believed would eventually have given rise to a condition related to arthritis deformans. To prove whether it is possible to produce arthritic changes through irritation from the joint cavity he injected blood into the joints of animals.

He does not wish to establish a new theory nor does he wish to support any of the existing theories of etiology on the basis of this work. He concludes, however, that injury of the subchondral capillaries, either through tearing or thrombosis, leads to vascularization of the joint cartilage and areas of necrosis. This in turn may cause decrease in elasticity of the cartilage. Yet he cannot deny that the theory of primary loss of elasticity (Pomner) may not apply to some cases, as, for example, where he injected free blood into the joint cavity, and yet the conception that metabolic cartilage may influence the subchondral vessels, although without proof, may be considered.—*E. D. Hauser, M.D., Rochester, Minn.*

Focal Infection and Arthritis. Nathan P. Stauffer. *Med. Journ. and Record*, December 3, 1924, p. 542.

Stauffer reports an intensive study on focal infections, with special reference to arthritis, to determine the numerical and if possible the causal relation of one to the other, on three hundred patients at the nose and throat department of the Presbyterian Hospital.

In a group of two hundred cases of arthritis over two-thirds had diseased tonsils, and twenty-five per cent. had sinuitis. The teeth were only grossly involved in ten per cent. of the patients, the involvement being decayed roots, unfilled cavities, pyorrhoea, or calcareous deposits on the teeth.

In twenty cases of acute rheumatism, fifty per cent. of the patients had diseased tonsils, and twenty-five per cent. sinuitis. In patients unable to walk on account of

their arthritis, seventy-five per cent. had diseased tonsils. Although some startling cures resulted from removal of tonsils combined with sinus operations, the vast majority were not markedly affected. Many had tonsillectomies before entering the hospital.

The most common bacteria found in tonsil cultures were, in order of frequency: streptococcus nonhemolyticus, streptococcus hemolyticus; streptococcus viridans; staphylococcus aureus; pneumococci, and bacillus proteus.—*Charles A. Parker, M.D., Chicago, Ill.*

RACHITIS

Correlation of Clinical, Roentgenologic, and Serologic Evidence of Rickets in Breast-Fed. L. R. DeBuys and L. von Meysenbug. J. A. M. A., November 15, 1924, p. 1563.

In this study sixty-eight breast-fed infants were examined for evidence of rickets by clinical, roentgenographic, and blood-chemistry observations. The blood calcium and the phosphate were determined. The average product of the two was about 50 (calcium 10 and phosphate 5). It was noted that the lower the product (below 30) the more frequently were the roentgen ray findings positive and the greater was the degree of clinical evidence of rickets. The authors believe that serologic examination for rickets is the most reliable procedure for determining the activity of the disease. Positive roentgenologic evidence is of decided value in the diagnosis of the disease. The most dependable of the clinical symptoms are epiphyseal enlargement and costal beading.—*F. G. Hodgson, M.D., Atlanta, Ga.*

The Underlying Cause in the Pathogenesis of Rickets. Leonard Findlay. *Jour. A.M.A.*, November 8, 1924, p. 1473.

An extremely interesting paper in which the author says that he can come to no other conclusion than that in rickets there is a diminished absorption of the calcium available in ample amount in the diet. It is very possible that rickets may be of intestinal origin and probably of the nature of an infection.—*Edward S. Hatch, M.D., New Orleans, La.*

Rickets as Influenced by Diet of Mother During Pregnancy and Lactation. A. F. Hess and Mildred Weinstock. J.A. M.A., November 15, 1924, p. 1558.

After a number of experiments upon rats and also feeding of cod liver oil to pregnant mothers, the following conclusions are reached. Rickets cannot be prevented by improving the diet of the mother (a) previous to pregnancy (b) during pregnancy and (c) throughout lactation, although it may be mitigated to a certain degree. Supplementing the diet of the mother for two generations also failed to render the young refractory. Infants were not protected by giving the mother cod liver oil during the last two months of pregnancy. Although the incidence and severity may be influenced by improving the nutrition of the mother, our main efforts should be toward improving the environment and nutrition of the infant.—*F. G. Hodgson, M.D., Atlanta, Ga.*

NEOPLASMS

STRUCTURAL VARIATIONS IN THYROID METASTASES IN BONE WITH REFERENCE TO BENIGN METASTATIC GOITRE. F. Gordon Bell. *British Journal of Surgery*, October, 1924, p. 331.

It has been customary to regard the thyroid gland as unique in the property of showing benign metastatic growths.

The evidence for this demands careful scrutiny.

1. Structural and functional features of the thyroid.
   There is a remarkably abundant blood supply, sinusoidal in character. The thyroid cell possesses exceptional potentialities with regard to size, number, and functional activity. The gland possesses a reserve supply of undeveloped epithelium which may respond to physiologic stimulus.
2. Errors in development and the osseous inclusion of aberrant thyroid tissue offers a possible explanation for tumors in the neck region.
3. The chief evidence for benign metastasis is derived from case reports.

The writer's object is to emphasize the unreliability of clinical and microscopic examination of the thyroid and to demonstrate that a thyroid tumor of bone of unquestionable malignancy may display a structure hardly distinguishable from a normal gland.

Three case reports are presented, the first a frankly malignant goitre with secondary deposit in a rib. The second case showed apparently innocent enlargement of one lobe, with appearance of secondary deposit in the sternum two years after removal of this lobe. The third case presented no abnormality of the thyroid discoverable during life, the first evidence being pathologic fracture of the femur. In this case physical examination of the neck showed no thyroid abnormality. Only on microscopic examination was unequivocal evidence obtained that the thyroid had given origin to the tumors in the femur and the ilium.

The histologic appearances of secondary thyroid deposits in bone vary with the type of parent tumor, the duration of the metastasis, and the local circumstances. The metastasis may function, and may undergo colloid or cystic changes.

More stress should be laid on the reaction produced by the deposit on the surrounding tissues and its capacity of eroding and destroying bone, than on its histologic characters.—*Alexander Gibson, F.R.C.S., Winnipeg, Manitoba.*

WHITE MYELOMA OF THE RADIUS. T. H. Burland and D. J. Harries. *British Journal of Surgery*, October, 1924, p. 254.

A child, aged nine, showed a myeloma involving the lower third of the radius.

At operation the lower portion of the radius was removed, leaving the epiphysis intact. The periosteum was left in situ except where invaded by the growth. A bone graft was taken from an ox-tibia and boiled for half an hour before insertion. The upper end was pushed into the medullary cavity. Radiographs at intervals up to fifteen months showed gradual absorption of the graft, and radial deviation of the hand. Movement was permitted three months after operation. Microscopic examination was made of the tumor itself, of the boundary zone between tumor and bone or bone-marrow, and of the marrow beyond the tumor.

Histology of the Tumor.

There are areas of closely packed spindle cells usually surrounding giant-cells. The giant cells are very numerous near the periphery. The nuclei may number from two or three up to twenty-four. There is nothing to indicate that the giant cells are angioblastic in origin.

Histology of the Boundary Region.

There are numerous blood extravasations and a great many giant cells or osteoclasts. These are not probably derived from marrow. Histological examination of the marrow beyond the boundary region showed no abnormality.

Discussion.

It is probable that a "Myeloid Sarcoma" is produced by the formation in abnormal numbers, by the fragmentation later of osteoclasts which remove the bone very quickly. The conditions normally determining the formation and activity of the osteoclasts are not known. The myeloma probably develops as the result of a localised condition "favoring the formation of osteoclasts."

The author favors the view of Kölliker that osteoclasts are derived from osteoblasts and ultimately break up into osteoblasts.

The spindle cells are probably not blood-borne, but arise by dedifferentiation, i.e., "the return of previously specialised elements to a simpler and more embryonic type."—*Alexander Gibson, F.R.C.S., Winnipeg, Manitoba.*

Roentgenographic Types of Sarcoma of the Long Bones. By Henry W. Meyerding. *Radiology*, December, 1924, p. 457.

Sarcomas of bone show roentgenographic features which, correlated with the history and clinical findings, make an early diagnosis possible in a large percentage of cases. They are originally central or periosteal in location, and sclerosing or rarefying in type.

The types illustrated are (1) Periosteal, with sun-ray appearance of the osteogenetic tissue. (2) The sclerosing type, with a central mass of increased density, at times invading the periosteum, and involving the entire bone. At times these tumors present the sun-ray appearance at their periphery. (3) A rarefied form, non-bone forming, periosteal in origin, and causing pressure absorption of the bone.

Central sarcomas may perforate the cortex and produce tumor masses resembling osteochondrofibromas. They may resemble cysts. Another distinct group rapidly destroys bone in all directions, perforating cortex and periosteum.

A sarcoma may extend through the capsule of a joint and present the picture of a destructive arthritis.—*Edward N. Reed, M.D., Los Angeles, Calif.*

Benign Foreign Body Giant-Cell Tumors in the Long Bones. Henry W. Meyerding. *Jour. A.M.A.*, October 25, 1924, p. 1323.

A group of twenty-four benign giant-cell tumors of the long bones are studied. These tumors, formerly considered malignant, are now classed as benign, and are regarded by some as attempts at repair following traumatic and low grade infectious processes. They usually occur in middle life and the patients are seldom sick.

The treatment should be as conservative as possible, good function being the aim of all treatment.—*Edward S. Hatch, M.D., New Orleans, La.*

OPERATIVE PROCEDURES

SURGERY OF THE KNEE JOINT. N. Allison. *Surg., Gyn., and Obstet.*, October, 1924, p. 409.

At the present time knee-joint surgery, if properly done, is not more dangerous than other surgery. In certain knee conditions, operations are more truly conservative than non-operative treatment. After discussing the pathology in infection of this joint the author states that, from the standpoint of function, the articular cartilage is the important structure to be preserved. If this structure is seriously damaged, joint function is more or less lost and it would seem the wiser policy to aid nature in her plan to obliterate the joint. We should discover the type of lesion in which surgery may preserve the cartilage intact, and when this is impossible, surgery should remove the barrier to ankylosis.

In non-infectious conditions, such as the "internal derangements" of the knee, the value of surgery is now well established. The diagnosis and accurate determination of the amount of damage to important structures can be made only upon inspection of the interior of the joint. Early diagnosis is essential for real conservative treatment. This is particularly true in infections.

In tuberculosis of the knee, excision is now generally employed in adults. In children the author advises to produce early ankylosis by removal of articular cartilages, being careful not to damage the epiphyses. The diagnosis should be made early by arthrotomy and pathologic examination of tissues and guinea pig inoculations. In acute infections of the knee, operation to flush the cavity and establish drainage, as by the Willems method, offers the only promise of conservation of knee joint function. —*R. W. Billington, M.D., Nashville, Tenn.*

TENODESIS OF THE QUADRICEPS TENDON AFTER SAXL. F. Barth. *Zeitsch. f. orthop. Chir.*, 1924, Vol. XLIII, pp. 579–585.

Previous to 1918, when the Saxl operation was first described, the flail knee joints and those with a quadriceps paralysis had been arthrodised. Since 1918, the author has adopted the method of stiffening the knee joint in extension by implanting the quadriceps tendon in the femur, as advocated by Saxl. Six cases have thus been operated on, and all gave satisfactory results. One case is already one and a quarter years old and the tenodesis is still perfect.

The advantages over an arthrodesis are: safe operative procedure, absence of injury to the bone, lack of disturbance in the growth of the leg, and rapid recovery without long recumbency. The great advantage is that the patient needs no splint or brace three months after the operation. By this time the knee is fixed in extension and genu recurvatum is not to be feared.—*A. Gottlieb, M.D., Los Angeles, Calif.*

PERIARTERIAL SYMPATHECTOMY. Kenneth Black. *Brit. Med. Jour.*, August 2, 1924, p. 165.

The author discusses briefly the theory of periarterial sympathectomy, giving credit to Claude Bernard as the instigator of the original experiments carried out in the rabbit.

Leriche of Lyons, in 1921, reported sixty-one cases of periarterial sympathectomy for the relief of various chronic lesions with only one complete failure.

The author, working on the assumption that the sympathetic vasoconstrictors extend along the arterial wall in the adventitia or outer coat, reports ten cases of leprous ulceration of the lower extremity, treated successfully by decortication of about one inch of the adventitia of the femoral artery. Healing of ulcers was obtained as early as two to three weeks in some of his first cases. In none of the cases were any untoward results noticed. The best results were obtained when there was an absence of much scar tissue about the ulcers.

The author's contra-indications for the performance of this operation are renal, hepatic, or cardiac disease or arterial degeneration.—*N. T. Williamson, M.D., Montreal.*

THE TRANSPLANTATION OF THE FIBROUS TISSUES IN THE REPAIR OF ANATOMICAL DEFECTS. W. E. Gallie and A. B. Le Mesurier. *British Journal of Surgery*, October, 1924, p. 289.

An account is given of experimental work in regard to transplantation of fascia, and of the use of fascial sutures.

Clinical application of the conclusions arrived at includes the use of "living sutures" in:—

Injuries to Tendons.

A case is described of severed flexor longus pollicis tendon of six months' standing. With the utmost tension, a gap of three-quarters of an inch persisted between the ends. A strip was cut from the palmaris longus tendon and used in bridging the gap. Active movement was permitted in three weeks. Seen four years afterwards, the function of the thumb was perfect. Four cases of ruptured patellar ligament have been treated on similar lines, the tendo Achillis being made use of. Ununited wounds of the tendo Achillis have been dealt with in the same way.

Injuries to Ligaments.

Habitual dislocation of the patella has been treated by the formation of a new ligament, mooring the patella to the internal condyle. It is suggested that the method might be used in recurrent dislocation of the shoulder joint. In ununited fracture of the patella the method has proved of value. In infantile paralysis of the shoulder in small children, the acromion may be woven to the greater tuberosity of the humerus with strips of fascia lata holding the humerus in moderate abduction. In congenital ptosis of the eyelids, suspension of the upper lid by a fascial sling has given satisfactory results in twelve patients. In visceroptosis, the application of the method is illustrated by two cases of floating kidney. In hernia, especially ventral hernia, an ideal condition is present for the use of living sutures. If a gap has to be left, the sutures may be woven across the opening as in a darn. In inguinal hernia, oblique and direct, a fertile field is available for the employment of living sutures.—*Alexander Gibson, F.R.C.S., Winnipeg, Manitoba.*

A NEW TECHNIQUE FOR ARTHRODESIS OF THE TARSAL JOINTS. Alexander Maclennan. *British Journal of Surgery*, October, 1924, p. 342.

In cases where there is deficient growth of the paralyzed leg fixation of the foot in extreme equinus position is advisable.

The Mikulicz operation of resection of the tarsus fails to gain the full possible lengthening. The operation to be described should not be performed before the age of nine, unless it be combined with a graft of bone extending from the tibia to the metatarsus.

The operation is carried out as follows:

Tourniquet. Dorsal incision to outer side of long flexor (extensor) of the great toe extends obliquely upwards from the space between the heads of the first and second metatarsal bones to the lower tibio-fibular joint. The incision reaches down to the bones, avoiding as much as possible the dorsal cutaneous nerves and the dorsalis pedis artery. The first and second metatarsal bones are separated by the knife from each other, a saw or osteotome is inserted, and the cuneiform (middle?), scaphoid, and astragalus are split vertically. By the aid of retractors, the split in the foot is forcibly widened. The various joints are erased by the osteotome and sharp spoon. The only difficulty in the operation will be found in rendering the obliteration of the astragalo-calcaneal joint complete. After closure of the wound, the foot is put up with a lateral straight wooden splint, followed after two weeks by plaster-of-Paris, which should be retained for eight weeks. A celluloid splint should be fitted for walking. When fixation has been achieved, after a lapse of about six months, an artificial boot may be made so as to distribute the pressure between the projecting heel and the balls of the toes.

Seven cases have been done on children between the ages of ten and twelve. The children walk without support of any kind other than a stiffened boot.—*Alexander Gibson, F.R.C.S., Winnipeg, Manitoba.*

THE INDICATIONS FOR SYMPATHETIC RAMISECTION, TOGETHER WITH OBSERVATIONS ON MUSCLE TONE. By N. D. Royle, M.B.Ch.M., *Medical Journal of Australia*, September 27, 1924, p. 313.

In view of the double innervation of skeletal muscles, and of the apparent failure of the principle of reciprocal innervation in spastic muscles, the author investigated the effect of the removal of sympathetic nerves on spinal, normal, and decerebrate animals.

In spinal animals, transection of the cord produces flaccid paralysis, followed by a spastic condition. Placed on its back, the lower limbs are held in flexion and adduction. Removal of the sympathetic results in a change from this position to one determined by gravity.

In normal animals placed supine, all the limbs are held in rigid extension. Excision of the sympathetics to one lower extremity did not prevent normal walking or running, and no wasting followed: but on placing the animal on its back, the limb deprived of sympathetic innervation assumed a position determined by mechanical forces, while the opposite limb was held in rigid extension. The conclusion is that the removal of the sympathetic makes necessary continuous volition for the maintenance of a defined position.

Sherrington described a condition present in decerebrate animals and called by him "plastic tone." This consists in the tendency of a limb to remain in the position imposed on it by passive movement, and has been shown to depend on reflexes from proprioceptors in the muscles themselves. The author's experiments showed that removal of the sympathetic destroyed this reaction of plastic tone, and greatly diminished reflex activity in the limb operated upon.

Sympathetic ramisectomy was then done on a human subject, in a case of spastic hemiplegia due to gunshot wound in the left parietal region. This resulted in (1) definite

diminution of rigidity; (2) diminution of reflex activity; (3) loss of tremor; (4) immediate and progressive gain in control of voluntary movement; (5) restoration of balancing power; (6) vaso-motor changes: viz, change in temperature and color of the limb following operation; (7) changes in bowel condition.

Experimental results and operative findings considered together: In spinal animals while sympathetic ramisectomy temporarily relieved flexion and adduction, this condition tended to recur. Removal of the sympathetic nerves can have much effect in spinal lesions only when there remains enough cortical control to inhibit the action of the spinal centers, and the amount of relief will depend upon the amount of cortical control able to pass the block in the spinal cord.

In cerebral lesions resulting in extensor spasm and associated with absence of cortical control, removal of the sympathetic had no beneficial result.

While the initiation of a movement is a function of the cortex, the mechanism of maintenance of a position is not so well understood. With improvement in cortical lesions and reappearance of voluntary control, voluntary movements are often obstructed by rigidity affecting all groups of muscles. The author has found that removal of all sympathetic influence adds greatly to the accuracy of movements and enables cortical inhibition to be much more effective.

The result of the author's operative work shows that:

1. The site and severity of lesions modify considerably the result of ramisectomy for spastic paralysis.
2. Gunshot wounds of the cortex invariably responded to treatment.
3. Congenital hemiplegia and paraplegia gave favorable results.
4. Lesions of the internal capsule and indefinite lesions associated with vascular changes were not so hopeful as regards the upper limb.
5. Nearly all lower limb spastic paralysis of cerebral origin improved following the operation.
6. Fine coördinations of the upper limb did not usually return.

It is pointed out that there can be no return of function if there is destruction of cortico-spinal connections. Absence of progressive lesion and the presence of fair amounts of cortical control are necessary for satisfactory results. Another main indication for the operation is that the rigidity be "plastic" in type.

The author found by experimentation that "muscle tone" does not take up the slack in a resting muscle, when its points of attachment are approximated.

In some spastic paralysis there are "lengthening and shortening reactions," such as are found in decerebrate animals. In decerebrate animals the knee jerk is easily excited, but its amplitude is not great; and after the exciting reflex there is a return to less than the previous degree of flexion, so that a series of knee jerks leaves the limb finally in almost complete extension. This is the phenomenon which Sherrington described as "plastic tone." Plastic tone has been shown to depend upon the sympathetic nerves.

Discussing further the distinction between "contractile" and "plastic tone." Contractile tone produces easy excitability and large amplitude of reflex, while plastic tone causes the tendency for the position of extension,—for example, in the knee jerk,—to be maintained. The tendency to maintain any position imposed by reflex or active contraction constitutes a large part of the disability of the spastic paralytic, and this tendency depends on plastic tone. The main indication for sympathetic ramisectomy is the presence of plastic tone. Imbecility and some degrees of mental deficiency are

contraindications to sympathetic ramisectomy.—*Edward N. Reed, M.D., Los Angeles, California.*

Synovectomy of the Knee Joint. J. S. Speed. *J. A. M. A.*, December 6, 1924, p. 1814.

The history of this operation and the embryologic development of the knee joint are briefly reviewed. No definite classification of the various types of chronic arthritis is attempted. Anything that causes repeated insult to a joint, whether it be toxic or traumatic in nature, calls forth a certain chain of reactions within the joint, and the end results will be very similar, regardless of the etiology. Cultures of these joints were almost invariably negative. Synovectomy is never performed until conservative treatment has failed to give relief. The articles by Jones and by Smith are quoted. Certain traumatic cases, especially with marked villous formation or enlarged fat pads, give good results. Two cases of benign tumor were operated on; also one case of osteochondromatosis. The operation was performed through a long incision medial to the patella, and the entire anterior chamber was cleaned out. A tourniquet was used. Active motion was begun as soon as possible: on the second or third day after operation. A Thomas splint with knee flexion attachment was applied and the limb suspended and physiotherapy was begun on the seventh to the tenth day.

Conclusions: 1. Synovectomy is a valuable procedure in properly selected cases and allows us to restore function to joints for which otherwise little can be done. 2. Monarticular lesions offer the best prognosis. 3. During the progressive stage of a polyarticular arthritis, it is of doubtful value as a routine.—*F. G. Hodgson, M.D., Atlanta, Ga.*

Foot-Drop. A New Operation for its Relief. R. Tunstall Taylor. *Southern Med. Jour.*, November, 1924, p. 849.

The author's operation has been done for drop-foot due to anterior poliomyelitis, cerebral hemiplegia, and monoplegia. He employs a strip of fascia lata, three-fourths inch wide, to suspend the foot. One end of fascia is passed upward through a longitudinal slit in the periosteum on the front of the tibia, then out from beneath this through a small transverse slit, the end being turned down and sutured to itself and adjacent periosteum. The lower end is carried down beneath the annular ligament to the astragalo-scaphoid joint, just external to the extensor longus hallucis. The lower end is then passed through an incision in the superior astragalo-scaphoid ligament and sutured so as to hold the foot in slight dorsal flexion. Sutures of fine silk or fascia lata are used. A plaster cast holds this position for six weeks. The tendo Achillis is lengthened, if necessary. Cases have been followed in both children and adults for over a year and show no relapses of deformity. It is believed that the fascia will not stretch and will at the same time adapt itself to growth in children. This belief, or hope, appears a bit sanguine.—*R. W. Billington, M.D., Nashville, Tenn.*

Disturbances of Other Foot in Amputations. M. zur Verth. *Med. Klinik*, November 2, 1924, p. 1544.

The question arose whether the left foot of a sailor, who had lost his right lower extremity through an amputation, was injured by an increased strain, and what ortho-

pædic means, if any, were warranted in way of treatment. The patient experienced subjective symptoms of foot strain without any measurable decrease in the height of the arch. The author concludes that this is a case where the foot was injured through the increased weight bearing of the left limb as a result of amputation of the right limb, and that a properly fitted arch support is indicated for treatment of the left foot.—*E. D. Hauser, M.D., Rochester, Minn.*

MISCELLANEOUS

Occult Spina Bifida. Dr. Walther Altschul. *Med. Klin.*, November, 1924, p. 1567.

The author takes up the question to what degree spina bifida occulta can be looked upon as a pathologic finding. Hintze wished to differentiate two types of spina bifida, namely a pathologic spina bifida occulta and a normal, lumbar or sacral fissure which he designated "fontanella lumbosacralis." The origin of both types of spina bifida is the same; an embryologic defect.

Two different types of spina bifida are recognized. The one shows a lumbar or a sacral fissure without clinical symptoms. The other shows normal roentgenographic findings of the spine, with a symptom of myelodysplasia (enuresis and deformed feet). In both instances the author believes there are cord changes; in the one case the changes are so minor as not to give rise to symptoms. His reason is that these cases, while apparently normal, will receive an irritation which would never give rise to symptoms in the normal, and develop symptoms of myelodysplasia. He cites three such cases.

He thus concludes that spina bifida is an anomaly which does diverge from the normal and yet is not an out-and-out pathologic finding. Spina bifida occulta with its concurrent cord changes represents a predisposition for symptoms, the sum total of which is included under the term myelodysplasia.—*E. D. Hauser, M.D., Rochester, Minn.*

The Treatment of Cerebral Spastic Paralysis with Special Reference to the Stoffel Operation. Frank D. Dickson. *Jour. A. M. A.*, October 18, 1924, p. 1236.

A very clear cut description of the reasons for doing the Stoffel operation. The author divides both the anterior and posterior ramus of the obturator for adductor spasm, and the nerve to the internal hamstrings in knee contractures, leaving the biceps intact. The extremities are kept in plaster for two weeks, after which movement and exercises are begun, and the casts are worn at night for a few weeks longer.—*Edward S. Hatch, M.D., New Orleans, La.*

Cessation and Restoration of Conduct in Peripheral Nerves by Thermal and Chemical Means. Philipp Erlacher. *Arch. f. Orthop. und Unfall-Chir.*, Vol. XXIII, No. 3, 1924, pp. 287–305.

In a series of experiments the author attempts to determine the possibility of stopping and restoring the nerve conduct by various measures, thermal and chemical. After freezing the conduction is restored in thirty days; after heating to 70° C., two months after the injection of hypertonic NaCl. solution, or 10% calcium chloride or

Pregls-pepsin solution, the nerve conduction is restored again after four weeks. Tests with 10% carbolic acid solution, with 3% silver nitrate solution, with alcohol and ammonia solutions, resulted in restoration of conduct in different lengths of time. The only longer continued interruptions of nerve conduction were obtained with saponin and formalin; it needed three months to restore nerve function. The peripheral nerve ending undergoes degeneration, while an ascending degeneration has never been observed.—*A. Gottlieb, M.D., Los Angeles, Calif.*

Fibrous Ankylosis of the Hand. A. Bruce Gill. *Jour. A. M. A.*, October 11, 1924, p. 1137.

Fibrous ankylosis of the fingers due to prolonged swelling is quite common. Splints should never include the fingers, and no pads or bands that would tend to slow up return circulation should be used. Correction of deformity should be treated by gradual flexion, baking, massage, and active use encouraged.—*Edward S. Hatch, M.D., New Orleans.*

Peroneal Spasms. Operative and Non-Operative Treatment of Peroneal Spasm of Foot. Louis A. O. Goddu. *Boston Medical and Surgical Journal*, September 25, 1924, p. 580.

The article considers a condition of the foot in which the ankle is freely movable backward and forward, but which is associated with pain and great spasm of the peroneal muscles, with taut tendons, when inversion toward supination is forcibly attempted. Dr. Goddu assigns four causes, as follows: Sprain, with possible fracture; arthritis, resulting in rigidity; exostosis, causing voluntary spasm; idiopathic, in adolescence, where no cause may be found.

Treatment advised varies according to the cause and severity of the case, and includes strapping, arch-supports, and manipulation under anaesthesia. Very often it may be necessary to cut the tendons, over-correct the foot and apply a gypsum splint for six weeks. This is to be followed by massage, use, and arch supports.

Six cases are reported.—*H. A. Pingree, M.D., Portland, Me.*

Köhler's Disease of the Tarsal Scaphoid. F. C. Kidner and Felipe Muro. *J. A. M. A.*, November 22, 1924, p. 1650.

The name os navicularis pedis retardatum is suggested for this condition. A case in a boy of 8 years is reported. The pain and disability were so persistent after conservative treatment that a piece of the scaphoid was excised. Pathologic examination revealed only an interference with normal development. After three weeks in casts and physiotherapy, gradual recovery resulted. The history, incidence, etiologic factors, symptomatology, Roentgen-ray appearance, and differential diagnosis are discussed. For treatment, rest in plaster-of-Paris, the foot being in varus and cavus, for two or three months is suggested.—*F. G. Hodgson, M.D., Atlanta, Ga.*

INTERMITTENT CLAUDICATION. Jacob Meyer. *Jour. A. M. A.*, November 1, 1924, p. 1414.

A very interesting case report of a patient who suffered from thrombo-angiitis obliterans of both lower extremities, necessitating amputation, who sixteen years later had the same condition involving the intestinal tract, as was proved by operation.—*Edward S. Hatch, M.D., New Orleans, La.*

ETIOLOGY OF LOOSE BODIES IN JOINTS. H. Nolle. *Deutsche med. Woch.*, August 15, 1924, p. 1120.

The origin of loose bodies in joints is still a problem. Trauma is undoubtedly a factor. In arthritis deformans and neuropathic joints a fragment of cartilage is often broken off and forms a loose body in the joint. Where neither trauma nor arthritis is present, osteochondritis dissecans and Axhausen's sequestration following emboli have been offered as hypothetical explanations. A rarer cause is the breaking off of an intra-articular cartilaginous exostosis; the author describes such a case.

Following an injury to the right knee, there occurred in a young man effusion and then crepitus with slight limitation of flexion. The roentgenogram showed a shadow like a bunch of grapes in the upper recess. Under local anesthesia the author found an irregular process made up of fibrous tissue cartilage and bone, fastened by means of a narrow stalk to the capsule. To see this process is to conclude that it is but another step from a pedunculated body to a loose body in the joint cavity.

In the literature, Sonntag drew attention to this rarer type of case as being of significance in the etiology of loose bodies. Lotsch also described two cases which, unlike Sonntag's and the author's, gave no history of a preceding trauma.—*E. D. Hauser, M.D., Rochester, Minn.*

KNEE JOINT INJURIES. DIAGNOSIS AND TREATMENT. Charles Ogilvy. *Med. Journ. and Record*, November 5, 1924, p. cxxix.

Ogilvy discusses the following conditions: traumatic synovitis; internal lateral ligament; injury to the internal semilunar cartilage; loose bodies, of which he distinguishes three types, the detached portion of bone or cartilage from injury, the small bodies from tuberculous or other forms of arthritis, and the chondromata, of which there may be hundreds. Then he takes up injuries to the crucial ligaments, avulsion of the tuberosity of the tibia, avulsion of the tibial spine, followed by arthrotomy of the knee-joint with Jones' two routes, and fractures of the patella.

In the traumas he advocates rest in plaster. When the cartilages continue to be sources of trouble he advises their removal. He follows this same course in the treatment of loose bodies. There are no new measures advocated, the article being a plain up-to-date summary of the care of these common joint conditions.—*Charles A. Parker, M.D., Chicago, Ill.*

THE PHYSIOLOGIC EFFECT OF MASSAGE. Ralph Pemberton, F. A. Cajori, and C. Y. Crouter. *J. A. M. A.*, November 29, 1924, p. 1761.

In connection with the study of arthritis and rheumatoid conditions, analysis has been attempted of some of the measures known to benefit these conditions. Con-

spicuous among these measures are exercise, the application of external heat, and massage. This study was made to determine the effect of massage on the composition of the blood and urine in five arthritic patients. The massage was given vigorously for one hour by a trained masseuse and very little definite chemical change was noted in either the blood or the urine. The favorable influence of massage on the rheumatic syndrome apparently finds its chief explanation in its influence on the circulation, including the capillary beds.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

Early Diagnosis of Joint Tuberculosis. Alan DeF. Smith. *Jour. A. M. A.*, November 15, 1924, p. 1569.

The author advises exploratory operation in all doubtful cases. Sixty-three cases form the basis of this paper. Twenty-five were suspected cases and the operation was performed for diagnosis. Thirty-eight were operated upon because an arthrodesis was indicated, and the tissues removed were examined Of the thirty-nine cases of proved tuberculosis an incorrect diagnosis was made on admission to the dispensary. Usually the diagnosis of tuberculosis is not made until the joint condition has been present for several years. The average duration of the cases admitted to the hospital was thirty-two months. One knee case had been treated in plaster-of-Paris cast for four years, when at exploratory operation no evidence of tuberculosis was found. Another had worn a brace eight months and was found to be non-tubercular. A positive von Pirquet test was obtained in all of the thirty-six proved cases. The test was also positive in fourteen out of twenty-one cases in which no evidence of tuberculosis was found. Guinea pig inoculation was resorted to in twenty-four cases, of which eighteen were proved positive by operation. In this group ten pigs proved positive and four negative. This laboratory test is useful when positive, but when negative is inconclusive and has the disadvantage of requiring six weeks for a result. Wassermann tests were made, but a positive Wassermann does not preclude tuberculosis. Two cases showed four plus, one proved to be tuberculous, and one non-tuberculous. The Roentgen ray is not of great value in the early stages of joint tuberculosis. It is often suggestive, but rarely conclusive. Of the thirty-six proved cases, it was doubtful in twenty-two.

Exploration of the joint is a safe and simple procedure and very little temporary and no permanent disability is caused thereby. The joint is inspected; several pieces of well selected tissue from different parts of the joint are removed and sent to the laboratory. The joint is closed without drainage and in two weeks the knee can be used and can be flexed to ninety degrees. The tissue removed is examined microscopically. In five cases out of seven in which a special search was made, acid fast bacilli were found. Guinea pigs were inoculated, either with fluid or tissue from the joint.

Because of the extreme importance of being certain of the diagnosis, exploratory operation is indicated in all doubtful cases. This is a very logical paper. Five cases are reported which show the value of this procedure. The work is from the clinic of the New York Orthopædic Dispensary and Hospital.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

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